"COMPARISON OF POSTOPERATIVE PAIN IN ELECTIVE DIVISION VERSUS PRESERVATION OF ILIOINGUINAL NERVE IN LICHTENSTEIN INGUINAL HERNIA REPAIR" A ONE YEAR SINGLE BLINDED RANDOMIZED CONTROL TRIAL AT KLES DR PRABHAKAR KORE HOSPITAL AND MRC, BELAGAVI

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This is to certify that the dissertation entitled **"COMPARISON OF POSTOPERATIVE PAIN IN ELECTIVE DIVISION VERSUS PRESERVATION OF ILIOINGUINAL NERVE IN LICHTENSTEIN INGUINAL HERNIA REPAIR" A ONE YEAR SINGLE BLINDED RANDOMIZED CONTROL TRIAL AT KLES DR PRABHAKAR KORE HOSPITAL AND MRC, BELAGAVI** is a bonafide research work done by **REG.NO. BH0115008**

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LIST OF ABBREVIATIONS USED

A	-	Study group
Approx.	-	Approximately
B	-	Control group
BC	-	Before Christ
BP	-	Blood pressure
BUN	-	Blood urea nitrogen
CI	-	Confidence interval
cm	-	Centimeter
COPD	-	Chronic obstructive pulmonary disease
CT	-	Computed tomography
ECG	-	Electrocardiogram
ED	-	Emergency department
e-PTFE	-	Expanded polytetrafluoroethylene
ESR	-	Erythrocyte sedimentation rate
EU	-	European Union
FBR	-	Foreign body reaction
GA	-	General anaesthetic
i.e.	-	That is
IASP	-	International Association for the Study of Pain
IPOM	-	IntraPeritoneal Onlay Mesh
IPQ	-	Inguinal Pain Questionnaire
kPA	-	Kilopascals
LA	-	Local anaesthesia
min	-	Minute

mm Hg	-	Millimeters of mercury
MRI	-	Magnetic resonance imaging
N	-	Newtons
n	-	Total number
ng	-	Nanogram
NHS	-	National Health Service
NMDA	-	N-methyl-D-aspartate
NSAID	-	Non-steroidal anti-inflammatory drug
p	-	Probability
RCT	-	Randomized controlled trials
SD	-	Standard deviation
TAPP	-	TransAbdominal PrePeritoneal
TEP	-	Totally ExtraPeritoneal
UK	-	United Kingdom
VAS	-	Visual Analogue Scale
VRS	-	Verbal Rating Scale
Vs.	-	Versus

ABSTRACT

Background and Objectives

Chronic groin pain is a significant problem following open hernia repair with mesh, although the pain is often mild in nature, the quality of life studies have shown that chronic pain irrespective of severity can significantly interfere with normal daily activity. Lichtenstein hernia repair is commonly recommended in the management of inguinal hernia.

Majority of chronic pain has been attributed to ilioinguinal nerve entrapment. Routine excision of the ilioinguinal nerve in an attempt to decrease the incidence of chronic groin pain caused by nerve entrapment, inflammation, fibrotic reactions around the nerve. So the present study was undertaken to evaluate post operative groin pain in the patients with ilioinguinal nerve excision (group A) vs ilioinguinal nerve preservation (group B) in Lichtenstein inguinal hernia repair.

Methodology

The present one year randomized controlled trial was conducted in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi from January 2016 to December 2016. A total of 80 patients undergoing Lichtenstein hernia repair were randomized into two groups of 40 each as group A (excision of ilioinguinal nerve) and group B (preservation of ilioinguinal nerve).

Results

In the present study all the patients in both the groups were males. The mean age (52.48 ± 14.31 vs 55.93 ± 14.25 years; p=0.2836) and duration of the symptoms (0.99 ± 0.90 years vs 1.12 ± 0.85 years; p=0.5334) in group A and group B was comparable. In this study comparing the VAS on all the five follow ups there was significant lower pain scores in ilioinguinal nerve excision group than ilioinguinal nerve preservation group. The results showed the incidence of postoperative groin pain with mean severity score of 3.50±1.40 vs 5.60±2.11 ; 1.38±1.56 vs 4.35 ±1.48 ; 0.43±0.55 vs 2.38±1.51;0.28±0.45 vs 1.43 ±1.45 ; and 0.20±0.41 vs 1.03±1.27at pod-1, 3,1 week, 4 weeks, and 3 months followup in group A and B respectively, were significant ($p<0.05$). The results showed the incidence of decrease in postoperative groin pain with mean severity score of 3.08±1.40 vs 3.23±1.95(pod-1 to 1week;p=0.9195) ; 3.23±1.25 vs 4.18 ±2.07(pod-1 to 4weeks;p=0.0259) ; and 3.30±1.26 vs 4.58±1.96 (pod-1 to 3months;p=0.021) in group A and group B respectively, were significant. Showing that the elective division of ilioinguinal nerve significantly reduced the post-operative pain as compared to preservation of ilioinginal nerve in Lichtenstein hernia repair.

Conclusion and interpretation

Based on the findings of the present study it may be concluded that, the elective division of ilioinguinal nerve significantly reduced the post-operative pain as compared to preservation of ilioinginal nerve in Lichtenstein hernia repair.

However the sample size and the follow up period in the current study is relatively short , a larger study sample and longer follow-up may be needed before any further conclusion can be made.

Although the study sample and follow period is short in this present study than the previous studies, it is still wise to recommend ilioinguinal neurectomy in patients undergoing anterior inguinal hernia mesh repair. So when performing Lichtenstein inguinal hernia repair, routine ilioinguinal neurectomy is a reasonable option.

Keywords

Ilioinguinal nerve; Inguinal hernia; Lichtenstein hernia repair; Neurectomy; Chronic groin pain.

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Chapter 1

Introduction

INTRODUCTION

Globally, inguinal hernia is the most common type of hernia, comprising of approximately 75% of all abdominal wall hernias.[1-3] Inguinal hernia repair is one of the most common general surgical operations worldwide accounting for 10 to 15% of all surgical procedures and is the second most common surgical procedure after appendicectomy.[2-4] It has been estimated that worldwide over 20 million repairs of inguinal hernia are carried out each year.[5]

Hernias may be generally defined as a “Protrusion of a viscus or part of the viscus through an abnormal opening in the walls of its containing cavity".[12] Inguinal hernias may be congenital or acquired, with latter being a common presentation. Essentially any risk factors that either increases intra-abdominal pressure or weakens the anterior abdominal wall may lead to the formation of an inguinal hernia. Known risk factors associated with hernia occurrence are smoking, positive family history, patent processus vaginalis, collagen disease, previous appendicectomy (open) and prostatectomy, patients with ascites, peritoneal dialysis, after long term heavy work and chronic obstructive pulmonary disease (COPD). It is interesting to note that occasional lifting, constipation and prostatism has not been proven to increase risk of inguinal hernias.[6]

In inguinal hernia patients may typically present with either groin pain or swelling/lump. The presence of swelling may be asymptomatic with respect to their daily activities. If symptomatic, the symptoms may be either minimal (intermittent discomfort/pain) or interfere with their daily activities. Furthermore they may present with incarceration where the hernia cannot be reduced into the abdominal cavity which may lead to strangulation.[7]

Ever since Bassini published his original description of inguinal hernia repair in 1887, many techniques for hernia repair such as Shouldice, Darning, Desarda, Modified Bassini, Lichtenstein mesh repair and the more recent laparoscopic repair have been published.[4,5] Laparoscopic and Lichtenstein mesh repair are becoming popular in recent days[10] as they are associated with rapid return to normal activities with low recurrence rates.[11]

For decades, long-term analysis of results of hernia repair concentrated on post operative pain and recurrence rates. More recently however, as techniques of prosthetic hernia repair evolved several studies have focused on aspects of chronic pain and quality of life after hernia repair.

Chronic post hernioplasty groin pain (Inguinodynia) is defined as pain lasting > 3 months after surgery. It is one of the most important complication occurring after inguinal hernia repair, occurs with greater frequency than previously thought.

The incidence of Inguinodynia varies among studies, ranging between 0% and 62.9%, with 10% of patients fitting in the moderate to severe pain group[65,86]. However, only 2%-4% of the patients are adversely affected by chronic groin pain in their everyday life and has a significant impact on the quality of life[17].

The ilioinguinal nerve is the most commonly involved nerve in perineural fibrosis as it has the highest risk for entrapment. The ilioinguinal nerve is the sensory nerve that innervates the skin over the groin region, the medial aspect of the thigh, the upper part of the scrotum and the penile root. Theoretically excision of ilioinguinal nerve would eliminate the possibility of inflammation neuralgia arising from entrapment, neuroma, fibrotic reactions. Yet controversies persists and the procedure is not widely accepted.[87, 97]

Our study aimed to assess the influence of elective division versus preservation of the ilioinguinal nerve on chronic groin pain after Lichtenstein inguinal hernia repair.

Chapter 2

Objectives

OBJECTIVES

The objective of the present study is to compare the incidence of postoperative pain following Lichtenstein inguinal hernia repair in elective division of ilioinguinal nerve versus preservation of ilioinguinal nerve.

Chapter 3

Review of Literature

REVIEW OF LITERATURE

In 1804, Astley Cooper defined hernia as a protrusion of any viscus from its proper cavity. The protruded parts are generally contained in a sac-like structure, formed by the membrane with which the cavity is naturally lined.[17]

Approximately 96% of all groin hernias are inguinal hernias, with the remaining 4% being femoral. Hernias are bilateral in 20% of cases. The most common abdominal wall hernia is an inguinal hernia with a male to female preponderance of 9 to 1.[18]

Historical notes

The earliest data regarding inguinal hernia have appeared from the Ebers papyrus (approx. 1552 BC) and the mummy of Merneptah (1224-1214 BC), which shows possible remaining signs of hernia surgery.[19] Over the following centuries, several documents described the anatomy and treatment of inguinal hernias with both surgical and non-surgical methods. Results were generally poor as surgical ability was fragmentary or even non-existent. Most people therefore received no treatment at all or, at best, employed the use of a truss. It was not until the second half of the 19th century, together with the introduction of anaesthesia and antiseptic techniques, that hernia surgery evolved. Edoardo Bassini, revolutionized the treatment of inguinal hernia by introducing the 'Bassini's repair' in Padua, Italy.[20]

EMBRYOLOGY[21]

During the 6th week of gestation, mesoderm from the myotomes which lie on either side of the vertebral column invades the somatopleure (primitive wall of the

abdomen). This area is occupied by the body stalk and the open midgut. The mesoderm forms a sheet like embryologic entity. After migrating laterally and ventrally, it differentiates to form the right and left rectus. Around 12th week, they approximate in the midline, closing the body wall. The lower abdominal wall is formed by a mesodermal layer, the so-called "secondary mesoderm". It envelops and invades the cloaca, thereby separating ectoderm from endoderm cranial to the cloaca. The embryology of inguinal canal is peculiar. In a highly synergistic way, the skin, parietal peritoneum, and embryologic and anatomic entities between them produce the future pathway of the testes. The skin will form the scrotum (scrotal folds) in male and labia (labial folds) in the female. The parietal peritoneum will produce the processes vaginalis. This peritoneal diverticulum is more important to the male fetus as it will permit the descent of the testes.

The processus vaginalis penetrate through embryologic entities between skin and peritoneum, forming the inguinal canal, so the downward journey of the testicle to the scrotum is allowed. In girls, the descent of the ovary outside the peritoneal cavity is forbidden. The processus vaginalis finally closes to obstruct ovarian exodus but leaves the formation of the inguinal canal in-situ.

The vaginal process carries extensions of the layers of the abdominal wall before it, which form the walls of the inguinal canal. In males, these layers also form the coverings of the spermatic cord and testes. The opening in the transversalis fascia, produced by vaginal process becomes the deep inguinal ring and the opening created in External oblique aponeurosis forms the superficial inguinal ring.[22]

SURGICAL ANATOMY[22-26]

The anterior abdominal wall extents from the costal margins and xiphoid process superiorly to the iliac crests, pubis and pubic symphysis inferiorly. The groin is a portion of the anterior abdominal wall below the level of the anterior superior iliac spines. Anterior abdominal wall tissues form the inguinal canal that connects the abdominal cavity to the scrotum in men, or the labia majora in women.

Soft tissue of the anterior abdominal wall

Superficial fascia

The superficial fascia of the abdominal wall lies between the skin and muscles of anterior abdominal wall. In the lower part, the fascia differentiates into superficial layer (camper's fascia) and deep membranous layer (scarpa's fascia) between which lie superficial vessels and nerves and, in the groin region, superficial inguinal lymph nodes.

a) Camper's fascia is thick, areolar in nature and contains variable amount of fat and is often greatly thickened in obese individuals. Inferiorly, it lies superficial to inguinal ligament and is continuous with superficial fascia of thigh, the outer layer of fascia covering the perineum, penis and scrotum. In this region, it is generally thin with very little adipose tissue and in the scrotum contains smooth muscle fibres, which form the dartos muscle. In females, it continues from the suprapubic skin of the abdomen into the labia majora and perineum.

b) Scarpa's fascia contains more elastic fibres and is loosely connected by areolar tissue to the aponeurosis of external oblique muscle, but in the midline it is adherent to linea alba and pubic symphysis. In males, it extends to form

superficial ligament of the penis and continues medially and inferiorly over penis and scrotum where it becomes continuous with membranous layer of the superficial fascia of the perineum.

Transversalis fascia

It is a thin layer of connective tissue lying between the inner surface of transversus abdominis and extraperitoneal fat. In the inguinal region, it is thick and dense, and augmented by the aponeurosis of transversus abdominis muscle. Medial to the femoral vessels it is thin and fused to pubis behind conjoint tendon. Some fibres spread laterally towards the anterior superior iliac spine, some fibres run medially behind rectus abdominis, and some descend to pubis behind conjoint tendon, forming deep crural arch. The curved fibres of this arch thicken the inferomedial part of the rim of the deep inguinal ring. The spermatic cord in male, or the round ligament of uterus in female, pass through the transversalis fascia at the deep ring. The transversalis fascia spreads onto these structures as the internal spermatic fascia surrounding the testes and blends with areolar tissue on the parietal layer of tunica vaginalis.

Superficial vessels

The anterior abdominal wall receives its blood supply from paired superior epigastric artery (terminal branch of internal thoracic artery), inferior epigastric artery (from the external iliac artery posterior to inguinal ligament) both run vertically through the tissues, and from paired posterior intercostal, subcostal and lumbar vessels running obliquely around the anterolateral aspects of the abdomen.

The other vessels are the superficial circumflex iliac and external pudendal vessels which arise from femoral artery. All the arteries are accompanied by their respective veins and form tributaries to the femoral vein.

Lymphatic drainage

The lymphatic vessels lie both superficial and deep to the deep fascia. Superficial lymphatics from the infra-umbilical region run with the superficial epigastric vessels and that of lumbar and gluteal regions run with the superficial circumflex iliac vessels and drain into the superficial inguinal nodes.

The deep lymphatic vessels accompany the deep arteries. The vessels from the posterior part of the abdominal wall run with the lumbar arteries to drain into lateral aortic and retro-aortic nodes. Vessels from upper abdominal wall run with superior epigastric vessels to drain into the parasternal nodes. Vessels of the lower abdominal wall drain into circumflex iliac, inferior epigastric and external iliac nodes.

Innervation

The 7^{th} to 12^{th} lower thoracic ventral rami run anteriorly from the intercostal spaces into the abdominal wall. The rectus muscle and external oblique are supplied by lower intercostal and subcostal nerves (T7 – T12), and the internal oblique and transverses by those same nerves with the addition of iliohypogastric and ilioinguinal nerves (L1). The ilio-inguinal nerve accompanies the spermatic cord and runs through the superficial inguinal ring, to supply the medial thigh proximal to the inguinal ligament, the root of the penis and upper anterior scrotum. In the female, the nerve exits the superficial ring to supply the mons pubis and labia majora. Iliohypogastric nerve has some fibres in common with subcostal and ilioinguinal nerve.

The genitofemoral nerve emerges onto the anterior surface of psoas major muscle. Its genital branch exits the pelvis via the deep inguinal ring and courses with the spermatic cord, supplying the cremaster muscle. Where as the femoral branches of the genitofemoral nerves (L1, L2) pass under the inguinal ligament, travel across the thigh, lateral to the saphenous opening, and then travel a short distance in the femoral sheath to supply the skin overlying it.

Inguinal canal

This is an oblique passage in the lower part of the anterior abdominal wall situated just above the medial half of inguinal ligament. It is about 4 cm long lying above the medial half of inguinal ligament. Its size varies with age, and although present in both sexes, is well developed in males. It extends from the deep inguinal ring, to the superficial inguinal ring. The ilioinguinal nerve passes through the inguinal canal in both the sexes.

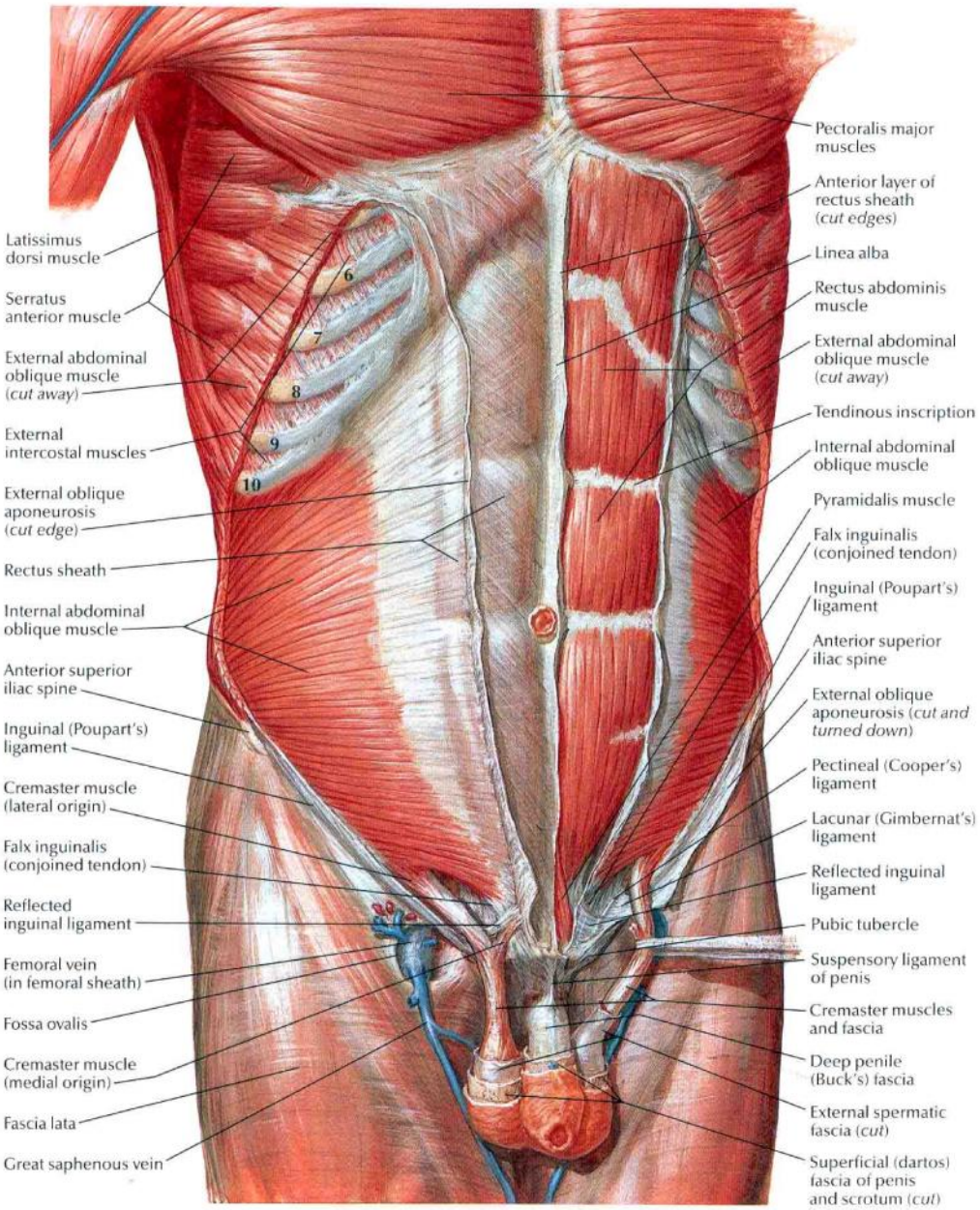


Figure 1. Muscles of the anterior abdominal wall.

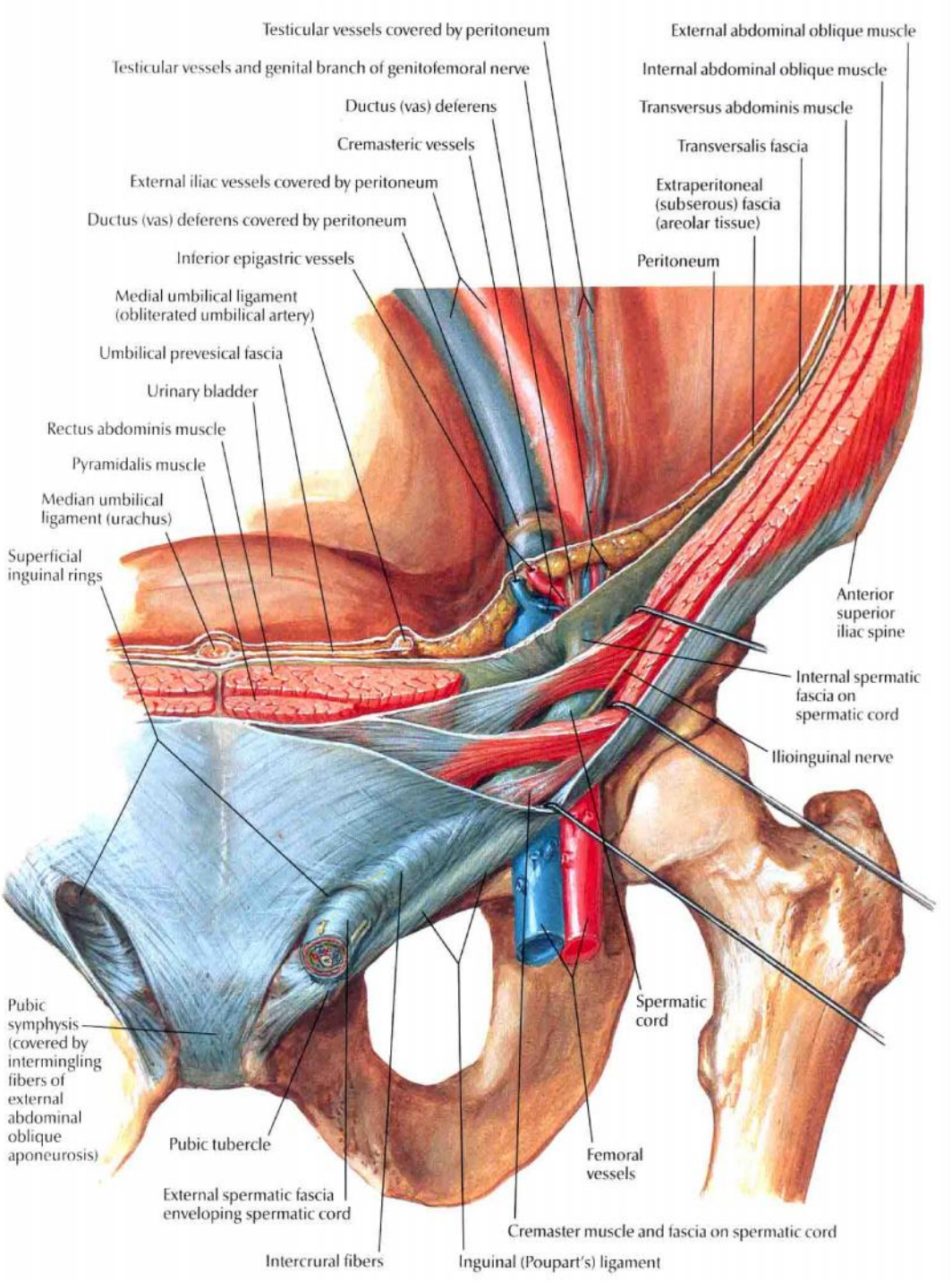


Figure 2: Inguinal canal in the male.

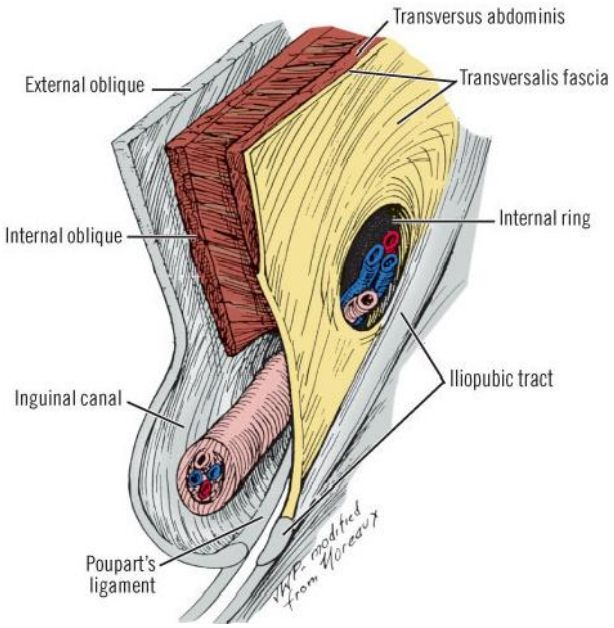


Figure 3: Parasagittal section through right mid-inguinal region, illustrating separation of musculoaponeurotic lamina into anterior and posterior inguinal walls.

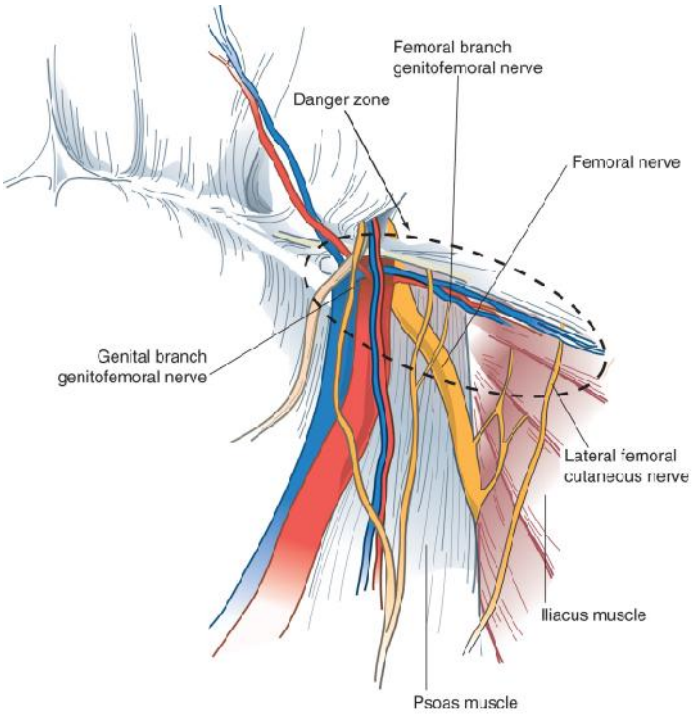


Figure 4: Important nerves and their relationship to the inguinal structures (right side).

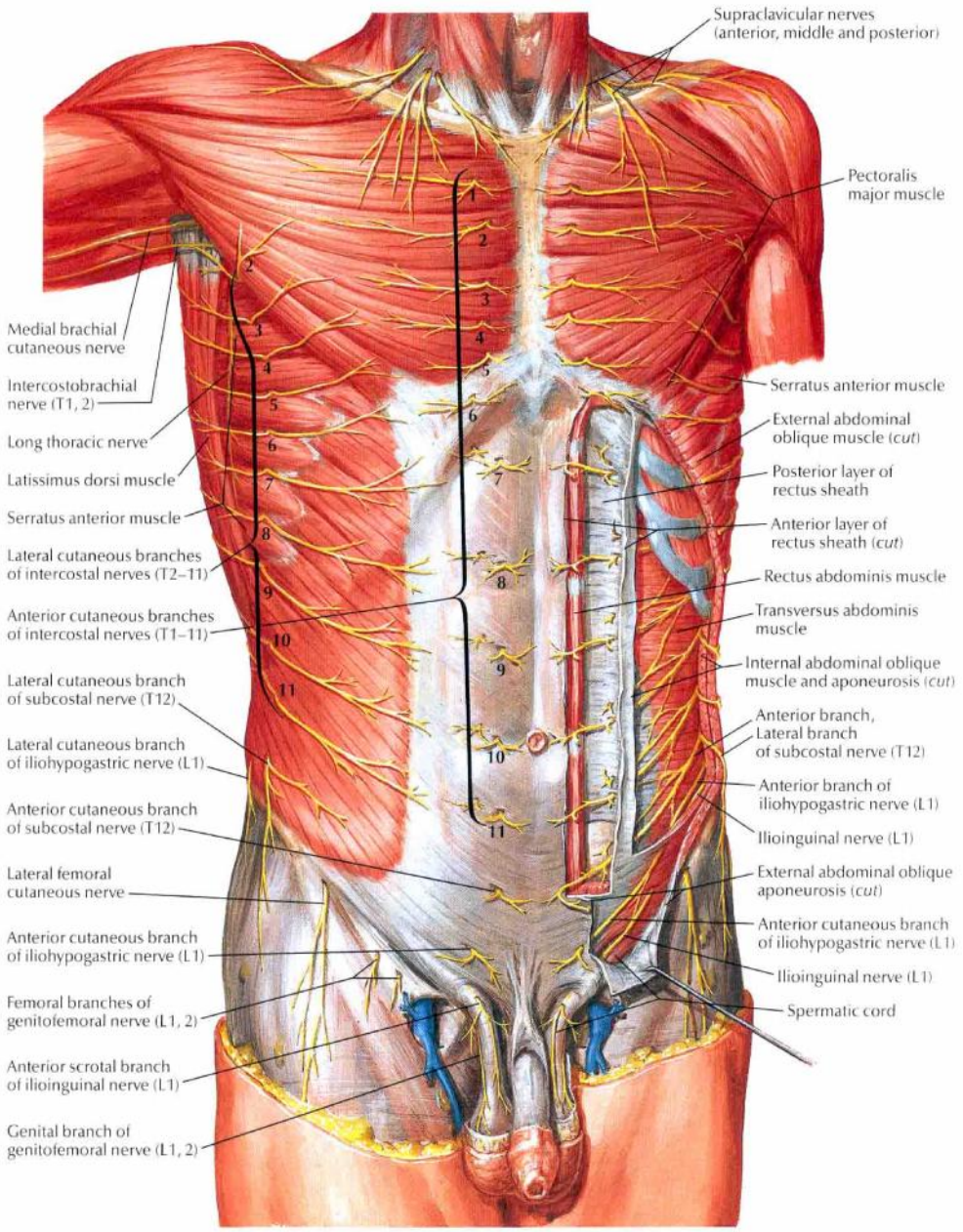


Figure 5. Nerve supply of the anterior abdominal wall in the male.

Superficial inguinal ring

It is a triangular gap in the external oblique aponeurosis, which lies above and lateral to the public crest, with apex pointing along the line of deep fibres of the aponeurosis. The base lies along crest of the pubis and its sides are the crura. The lateral crus is stronger and is reinforced by fibres of the inguinal ligament inserted into the pubic tubercle. The medial crus is thin and attached to the pubis symphysis and interlace with fibres from the opposite side. A few fibres arch over the apex of the ring as intercrural fibres. In males, the lateral crus is curved to form a groove in which the spermatic cord vests.

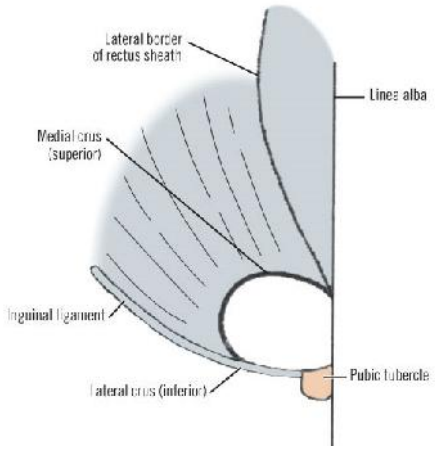


Figure 06: Diagrammatic representation of the external inguinal ring

Deep inguinal ring

It is an oval opening in the fascia transversalis, located midway between the anterior superior iliac spine and symphysis pubis, approximately 1.25 cm above the inguinal ligament. It is bounded, above and laterally, by the arched lower margin of the transversalis fascia; below and medially, by the inferior epigastric vessels.

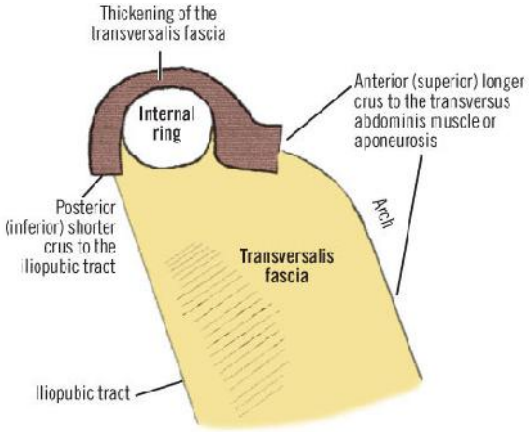


Figure 07: Surgical anatomy of the internal inguinal ring

Boundaries of the inguinal canal

Anterior wall

The inguinal canal is bounded anteriorly by the skin, superficial fascia and the aponeurosis of the external oblique. In the lateral one-third, the anterior wall is reinforced by the muscular fibres of internal oblique muscle just above the origin from the inguinal ligament.

Posterior wall

Medially the posterior wall consists of a strong conjoint tendon, formed by internal oblique muscle and transversus abdominis muscle. Lateral to the conjoint tendon, lies the transversalis fascia and reflected part of the inguinal ligament, which separate the inguinal canal from extraperitoneal connective tissue and peritoneum. Laterally the transversalis fascia in the posterior wall is strengthened by the tendinous muscle fibres derived from transverse abdominis muscle constituting the interfoveolar ligament.

Roof of the canal

This is formed by the arched fibres of internal oblique and transverse abdominis muscles. The fleshy fibres of internal oblique arise from lateral two thirds of the inguinal ligament. The fibres that arise from the inguinal ligament continues as an aponeurosis, that is attached to the crest of the pubic bone, and laterally, to the pectineal line.

Floor

It is formed by the union of the transversalis fascia with the inguinal ligament and medially by the lacunar ligament. The lacunar ligament is a thick triangular band of tissue lying posterior to medial end of inguinal ligament. It is formed from fibres of medial inguinal ligament and fibres from the fascia lata of thigh. The inguinal fibres run posteriorly and laterally to the medial end of the pectineal line, and are continuous with the pectineal fascia. The apex of the triangle is attached to the pubic tubercle.

A strong, fibrous band,i.e the pectineal ligament of Astley cooper extends laterally along the pectineal line. Fibres from the fascia lata join the inferior posterior border of the inguinal ligament; the latter, in combination with fibres from the transversalis fascia, fuses with the pectineal fasica as it joins the thickened periosteum of the pectineal line.

Relations

The inferior epigastric vessels lie posterior to the inguinal canal medially. They lie on the transversalis fascia, as they ascend obliquely behind the conjoint tendon and pass posterior to the rectus sheath.

The Hesselbach's triangle is bounded inferiorly by medial half of inguinal ligament, medially by lower lateral border of rectus sheath and laterally by inferior epigastric artery. A hernial sac passing lateral to the artery (i.e. through the deep ring) is an indirect hernia, and the one passing medial to the artery through the Hesselbach's triangle is a direct hernia.

Fruchaud's myopectineal orifice

This area in the groin is bounded as follows

Superior: Arch of internal oblique muscle and transversus abdominis muscle

Inferior: Pecten pubis

Medial: Lateral border of rectus muscle and its anterior lamina

Lateral: Iliopsoas muscle

All the hernias of the groin begin within the groin through this myopectineal orifice.

Spermatic cord

The spermatic cord begins in the preperitoneal space with the confluence of testicular artery and vein and ductus deferens, traversing through the deep inguinal ring. Three coverings of spermatic cord from inside out are:

1. Internal spermatic fascia – derived from the fascia transversalis at the deep inguinal ring.
2. Cremaster muscle and cremasteric fascia – It arises from the internal oblique and transverse abdominis muscle. The fibres spiral down the cord and loop back to get attached to public tubercle.
3. External spermatic fascia – derived from the external oblique aponeurosis as the cord passes between the crura of the superficial ring.

The cremaster muscle can elevate the testes forwards or even into the inguinal canal; though the fibres are skeletal, the action is reflex rather than voluntary. This cremasteric reflex is particularly active in infants and children and must be kept in mind when examining the scrotum in young to avoid a misdiagnosis of an undescended testis. The contents of the cord;

1. The Ductus deferens, lies in the lower and posterior part of the cord.
2. Arteries – Testicular artery, artery to duct, and the cremasteric artery.
3. Veins – Pampiniform plexus of veins, cremasteric veins, veins of ductus deferens.
4. Lymphatics – especially those from the testis draining to para-aortic and interaortocaval lymph nodes, but some from the coverings of the cord draining into external iliac nodes.
5. Nerves – Genital branch of genitofemoral nerve supplying the cremaster muscle. Other nerves are sympathetic twigs which accompany the arteries.
6. Processus vaginalis –this is the obliterated remains of the peritoneal connection with the tunica vaginalis of the testis. If patent, it forms the sac of an indirect inguinal hernia.

Epidemiology, Etiology and Pathophysiology [29, 30, 79, 80]

Seventy –five percent of all abdominal hernias are found in the groin; of which 95% are hernias of the inguinal canal with the remainder being femoral hernia defects. Inguinal hernias are 9 times more common in men than in women, they still remain the most common hernia in women .The overall lifetime risk of developing a groin hernia is approximately 15% in males and less than 5% in females. There is clearly an association between age and hernia diagnosis. In the same way the complications of hernias (incarceration, strangulation, bowel obstruction) are found commonly at the extremes of age.

Currently in this country approximately 700,000 operations for inguinal hernia repair are performed annually.

The cause of hernia is multifactorial and it is assumed that the following factors are involved.

1. Evolution

The absence of posterior rectus sheath below the arcuate line and only rather substantial transversalis fascia unsupported by muscles or aponeurosis resisting the intra-abdominal pressure and holding the breach between the abdomen and the thigh. It is compounded by humans having adopted the upright posture and change from quadrupedal to bipedal locomotion. The upright posture causes gravitational stress to pass down to the lower abdominal wall, which is structurally not designed for it nor has the evolution suited it for its new role.

2. Congenital and anatomical factors

A. Patent processus vaginalis: is the prime cause of indirect inguinal hernia in infants and children. The development of processus vaginalis, its migration and its final obliteration are intimately linked to the descent of the testis from the abdominal cavity into the scrotum.

The incidence of patent processus vaginalis in adults who do not develop hernia during their life is up to 20%.

B. Subtle varieties in the attachment and arrangement of abdominal muscles.

C. Females are particularly free of direct inguinal hernia: The narrowness of the interval between the transversus arch and the inguinal ligament and the hermetical attachment of external oblique aponeurosis are the important factors in protecting women against direct hernia. On the other hand, musculoaponeurotic attachments in woman are such that they frequently develop femoral hernia. Other factors that are

significant in the etiology are the number of aponeurotic fibers in the transversus aponeurosis which determines the intrinsic strength of the layer. The disposition of the transversus arch in relation to the iliopubic tract indirectly determines the size of the inguinal gap or defect in the hesselbach's triangle.

D. The obliquity of the inguinal canal: During sudden exertion increases the intraperitoneal pressure, compresse in the anterior and posterior walls of the canal there by occluding the canal.

3. Shutter mechanism

The accepted explanation for this is the physiologic "'shutter mechanism" which is activated, when the abdominal muscles contract to raise the intra abdominal pressure. As the internal oblique and transverse abdominis muscles contract, their lower fibers forming the myoaponeurotic roof of the inguinal canal "the conjoined tendon", that arches over the spermatic cord also sharply contracts and as the fibers shorten, the arch straightens out and descends to come to lie close to or on the inguinal ligament and so covers and protects the fascia transversalis. The shutter also passes down in front of the internal ring and counteracts the pressure on the ring from inside the abdomen. Contraction of the transversus

Abdominis muscle also pulls up and tenses the crurae of the internal ring which make up the thickened bands of the iliopubic tract and fascia transversalis causing the ring to close like a sphincter snugly around the cord.

4. Integrity of the fascia transversalis[79]

The ability of the fascia transversalis to withstand physiologic and pathologic elevations in the intra abdominal pressure is dependent on the state of the collagen fibers that make up its tissues and give its strength. The factor which interferes with normal production of collagen or causes its increased destruction or abnormal

production of collagen fibers decreases the strength of transversalis fascia. These factors include congenital connective tissue disorders like marfan's, ehler-danlos and hurler-hunter syndromes and mesenchymal metabolic defects. It is found that substances in cigarette smoke inactivate anti-proteases in lung tissues and so upset the protease/antiprotease system which is responsible for destruction of elastin and collagen of the rectus sheath and fascia transversalis and predispose to herniation in smokers.

5. General contributing factors

Like weakening of muscle and fascia by advancing age, lack of physical exercise, obesity and multiple pregnancies. Loss of weight and body fitness as may occur after illness, operation or prolonged bed rest, very low and unduly long transverse abdominal incisions for gynecological, urological and appendicectomy incision. Pulmonary diseases like COPD and emphysema, prostatism, chronic constipation, diverticular disease, genito-urinary causes like cystitis, cystocele and urethrocele contribute to the formation of groin hernia.

3. Coverings[27]

Coverings in case of an indirect inguinal hernia are, from inside out, as follows:

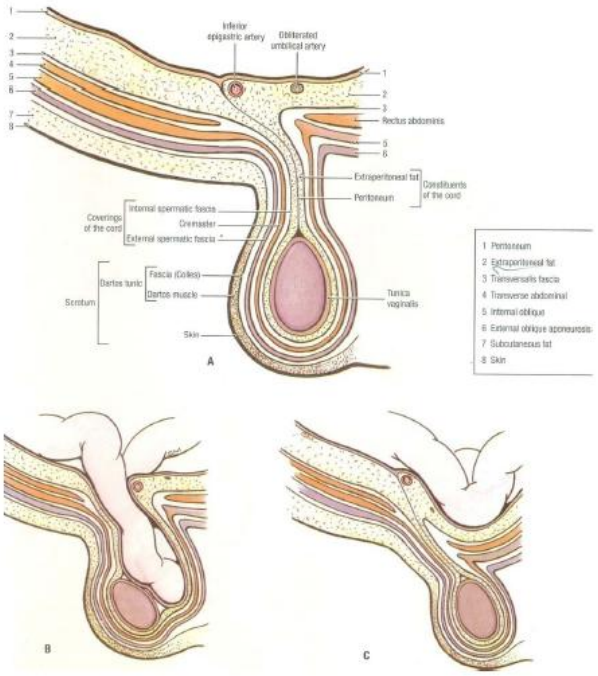


Figure - 08. Coverings of inguinal hernia (A), Indirect (B), and Direct (C)

Components of Inguinal Hernia[13]

1. The sac consists of a diverticulum of peritoneum, which is divided into mouth, neck, body and fundus.

Mouth: This is the part between the sac interior and the abdominal cavity.

Neck: This is the narrowest section between the mouth and the body of the sac.

Body: It lies between the neck and the fundus.

Fundus: This is the blind end or the distal most part of the sac.

2. Contents of Hernia

These can be almost any abdominal viscera, except the liver. The commonest are;

a. Fluid - Derived from peritoneal exudates, usually in congenital hernias..

b. Omentum - Omentocele (Synonym -Epiplocele).

c. A loop of intestine - Enterocele (Usually small intestine, but in some instances large intestine or vermiform appendix).

d. A portion of the circumference of the intestine - Richter's hernia.

e. A portion of urinary bladder wall or a diverticulum of the bladder.

f. Ovary with or without the corresponding Fallopian tube.

g. Meckel's diverticulum - Littre's Hernia.

h. Two loops of intestine in the manner of W - Maydl's hernia.

i. Rarely stomach, spleen or caecum may be found within the sac.

j. Sliding or Hernia-en-Glissade (Contents - Caecum, Urinary bladder).

k. Maydl's hernia or Hernia-en-W (Contents-W shaped loop of intestine).

l. Dual hernia (saddle or pantaloon). Hernia, on either side of the inferior epigastric vessels.

CLASSIFICATION OF INGUINAL HERNIAS [18,31]

Clinical Classification

This is based on the clinical presentation of hernia:

• Reducible hernia

• Irreducible hernia

• Obstructed hernia (Incarcerated hernia)

• Strangulated hernia

• Inflamed hernia

Gilbert's Classification (Addition by Rutkow and Robbins)

It is based on anatomical and functional defects established intra-operatively, categorized groin hernias in to 5 types. Type1, 2 and 3 were indirect whereas type 4 and 5 were direct.

Indirect Hernia

Type I: Snug internal ring, intact canal floor.

Type II: One finger breadth internal ring, intact canal floor. Not more than 4 cms.

Type III: Two-finger breadth internal ring. Canal floor is defective (Scrotal and sliding hernias).

Direct Hernia

Type IV: Entire canal floor defective, no peritoneal sac anterior to canal floor, intact internal ring.

Type V: Diverticular defect, admitting no more than one finger, internal ring intact.

Type VI: Consists of both direct and indirect components.

Type VII: Covers all femoral hernias.

Nyhus Classification of Groin Hernias

Is based on strict anatomic criteria, focusing on functional state of the internal ring and posterior wall of the inguinal canal.

Type I: Indirect inguinal hernia -- internal inguinal ring normal (Congenital hernia).

Type II: Indirect inguinal hernia -- internal ring dilated but posterior inguinal wall intact, inferior deep epigastric vessels not displaced.

Type III: Posterior wall defects

A. Direct inguinal hernia.

B. Indirect inguinal hernia - internal ring dilated, medially encroaching or destroying the transversalis fascia of the Hesselbach's triangle. (e.g. Massive scrotal, Sliding or Pantaloon hernias).

C. Femoral hernia.

Type IV: Recurrent hernias

Classification as per the Patency of Processus Vaginalis

a.Vaginal hernia:

b.Infantile hernia:

c.Funicular hernia:

BENDAVID TSD CLASSIFICATION

Type:

1) Anterolateral (indirect)

2) Anteromedial (direct)

3) Posteromedial (femoral)

4) Posterolateral (perivascular)

Stage:

I. Sac in canal

II. Sac outside external ring

III. Sac into scrotum

Anatomical Classification

a. Direct hernia

b. Indirect hernia

c. Femoral hernia

Classification according to Descent of the Sac

A. Bubonocele

B. Funicular

C. Complete

HISTORY AND PRESENTATION[35,36]

History

Age: Inguinal hernias occur at all ages. They may be present at birth or appear suddenly in an 80 year old. Peak times of presentation are in the first few months of life, in the late teens and early 20's and between 10 and 60 years. Indirect hernias are seen in young individuals where as direct are seen in older subjects.

Sex: Males are 20 times more commonly affected than females.

Occupation: Heavy work, especially lifting puts a great strain on the abdominal muscles. If there is an underlying weakness, the appearance of a hernia may coincide with strenuous physical effort. Hard labour workers, sportsmen and weight lifters are more prone.

Associated diseases:

Many a times, hernia is due to diseases causing weakness of anterior abdominal wall like obesity, previous lower abdominal operations, ascites and Malgaigne's bulges. Certain diseases lead to increase in abdominal pressure such as prostatic enlargement, stricture urethra, chronic cough and respiratory disorders and chronic smoking.

Local symptoms:

Pain: The commonest symptoms are discomfort, heaviness and pain in the initial stages. The patient complains of a dragging, aching sensation in the groin, which gets worse as the day passes.

Lump: A lump in the groin is the second most common complaint. This may be a small lump of 2-3 cms or a huge lump going down to the knee level. Patient feels that it gets smaller when he lies down and bigger when he strains or stands.

Systemic symptoms:

If the hernia is obstructing the lumen of a loop of bowel, the patient may complain of one or more of the four cardinal symptoms of intestinal obstruction – colicky abdominal pain, vomiting, abdominal distension and absolute constipation. In late cases of strangulation where gangrene has set in, patient can present with features of peritonitis, more so if perforation of bowel has occurred.

Signs:

Inspection: In standing position, a bulge or swelling will be seen in groin. This might disappear on lying down, if the hernia is reducible spontaneously in direct hernia. Impulse on coughing is present in reducible hernia. Loss of rugosities of scrotal skin in large inguino-scrotal hernias is seen. Visible peristalsis is seen in enterocele. Malgaigne's bulges are seen in patients with lax abdominal wall. An indirect hernia is sausage or pear shaped and lies parallel to the inguinal ligament. After reduction it reappears more laterally and runs down above the inguinal ligament towards the scrotum. A direct hernia is more rounded, more medial, bulges forward and tends not to go down to scrotum. After reduction it reappears in a forward direction.

Palpation: Reducing the hernia by manipulation is called taxis and it is performed in lying down position of the patient. As the hernia is reduced following features are noted:

a. Gurgling sound is felt in enterocele.

b. In enterocele first part takes longer to reduce and in omentocele later part.

c. Impulse on coughing is felt.

Internal Ring Occlusion Test: Internal ring is occluded and patient is asked to cough. If a bulge is seen medial to the occluding finger, then it is a direct hernia, if not an indirect hernia.

External Ring Occlusion Test: After complete reduction, the external ring is occluded with a finger and patient is asked to stand up gently. The reducible inguinoscrotal swelling will not come down as its descent is prevented by occluding finger, where as swelling fills gradually from below in case of varicocele and lymphvarix.

Finger Invagination Test: After reduction of the hernia, this test may be performed to palpate the hernial orifice. The skin is invaginated from the bottom of the scrotum by little finger, which is pushed up to palpate the pubic tubercle. The finger is then rotated and pushed further up into the superficial inguinal ring.

Normal ring is a triangular slit which admits only the tip of a finger. When the finger enters the ring, it goes directly backwards in direct hernia and it goes upwards, backwards and outwards in indirect hernia. The finger is again rotated so that the pulp of the finger faces backwards. The patient is again asked to cough. If the impulse is felt on the pulp of the finger, the hernia is a direct one, if it is felt on the tip, then it is an indirect hernia. “Sharma’s ring”, may be felt in the
sac during finger invagination test.

Percussion: Over the swelling, tympanic, if it is an enterocele and impaired or dull in case of omentocele.

Auscultation: Bowel sounds will be heard in enterocele.

Always examine

1. External genitalia

• scrotum for thickened spermatic cord.

• epididymis and testes.

• prepuce for phimosis and external urethral meatus for pinhole meatus.

2. Per rectal examination

3. Per abdomen examination: to rule out any abdominal mass, ascites and divarication of recti.

4. Respiratory system: to rule out COPD and koch's.

Differential diagnosis of inguinal hernia

I. When the swelling is incomplete i.e. an inguinal or a groin swelling:

A. Femoral hernia.

B. Enlarged inguinal lymph nodes.

C. Saphena varix:

D. Femoral aneurysm.

E. Encysted hydrocele of the cord.

F. Lipoma of the cord.

G. Undescended or ectopic testis.

H. Psoas abscess.

I. Malgaigne bulges.

J. Spermatocele.

K. Lymph varix.

II. When the swelling is complete i.e., inguinoscrotal swelling.

A. Infantile hydrocele.

B. Congenital hydrocele.

C. Encysted hydrocele of the cord: already discussed.

D. Varicocele.

Complications of groin hernia [38]

Certain complications are well recognized. Others are not.

• irreducibility

• incarceration

• reduction-en-masse

• strangulation

• gangrene

• peritonitis due to perforation of the intestinal wall and

• malignant mesothelioma (very rarely).

INVESTIGATIONS

Routine investigations like complete blood counts, urine examination, blood sugars and renal function tests.

Ultrasonography

- Ultrasonography can be used in differentiating masses in the groin or abdominal wall or in differentiating testicular sources of swelling.
- If an incarcerated or strangulated hernia is suspected, the following imaging studies can be performed:
    - Upright chest radiograph to exclude free air (extremely rare)
    - Flat and upright abdominal films to diagnose a small bowel obstruction.

MANAGEMENT

Non operative management

Fitzgibbons and colleagues recently reported the first prospective randomized trial of a watchful waiting strategy for patients with asymptomatic or minimally symptomatic inguinal hernias.[40] These investigators randomized more than 700 men to either a watchful waiting or open tension-free hernia repair. The risk for hernia incarceration in the watchful waiting group was extremely low at 1.8 per thousand patient-years, or 0.03% of study participants. This study provides conclusive evidence that a strategy of watchful waiting is safe for elderly patients with asymptomatic or minimally symptomatic inguinal hernias, and that even though almost 25% of patients eventually undergo repair, when they do, the operative risks and complication rates are no different than those of patients undergoing prophylactic repair.

Patients electing non-operative management can occasionally have symptomatic improvements with the use of a truss. This approach is more commonly used in Europe. Correct measurement and fitting are important. Hernia control has been reported in about 30% of patients. Complications associated with the use of a truss include testicular atrophy, ilioinguinal or femoral neuritis, and hernia incarceration.

Operative Management

Surgery is the treatment of choice varying from a nylon darn, Shouldice layered, Lichtenstein mesh to a laparoscopic repair. The optimal repair has been assessed by randomized clinical trials and population based studies.[37]

Indications

Surgery is the only curing treatment for an inguinal hernia. Hernia symptoms in patients that cannot be operated on, due to poor health or an unwillingness to be operated on, can sometimes be reduced by a hernia bandage (truss). The only important reason to operate an asymptomatic inguinal hernia is to reduce the risk of strangulation. In men this risk is low but since that risk is considerably higher in women, due to the higher frequency of and often misdiagnosed femoral hernias, it is often recommended that women with inguinal hernias are operated upon. On the other hand many patients who undergo an emergency operation due to a strangulated hernia do not know that they have a hernia or in case they know, this has not bothered them at all.

Repair techniques:

Anterior repairs

Inguinal hernia surgery can at least be traced back to Alexandria 300 BC. At that time the anatomical knowledge was limited and the surgical techniques seem to have included closing of the hernial sac with or without removing the ipsilateral testis. 150 years ago the surgical repairs were performed subcutaneously including ligation of the sac, narrowing of the external opening and reinforcement of the anterior wall. The recurrence rates were depressingly high, almost 100%. Many authorities stated that hernia surgery should not be performed. Technical improvements like better sutures together with improved anatomical knowledge as well as new anaesthetic and antiseptic methods helped introducing “modern” repair techniques for inguinal hernia surgery. Between 1870 and 1900 a lot of new repair methods were introduced, often accompanied with very promising results.

Sutured repairs

Henry O. Marcy[41] described the Marcy repair in its initial form in 1871 who also promoted the aseptic technique in surgery. It consists of high ligation of the hernial sac and narrowing of the deep ring. Nowadays the technique is used for lateral hernias in children and in growing youths.

The Bassini's repair

Eduardo Bassini Initially reported in 1887[42]. A large monograph was published two years later in Italian[43] on his technique which included many beautiful pictures, but the method gained wide recognition when his monograph was translated to German and republished[44] again in 1890. Dissection of the inguinal canal, defining of the hernial sac, high ligation in case of a lateral sac and incision of the posterior floor were essential. Reconstruction of the posterior floor was then done by interrupted nonreabsorbable suturing of the internal oblique muscle, the transverse abdominis and the transverse fascia to the iliopubic tract and the inner parts of the inguinal ligament.

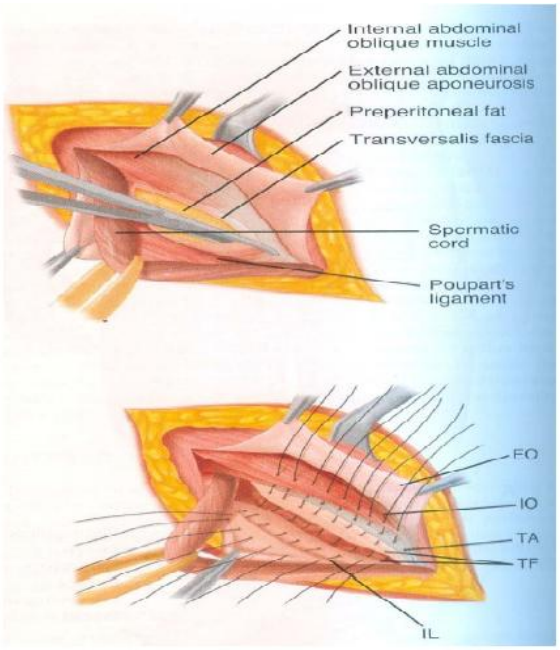


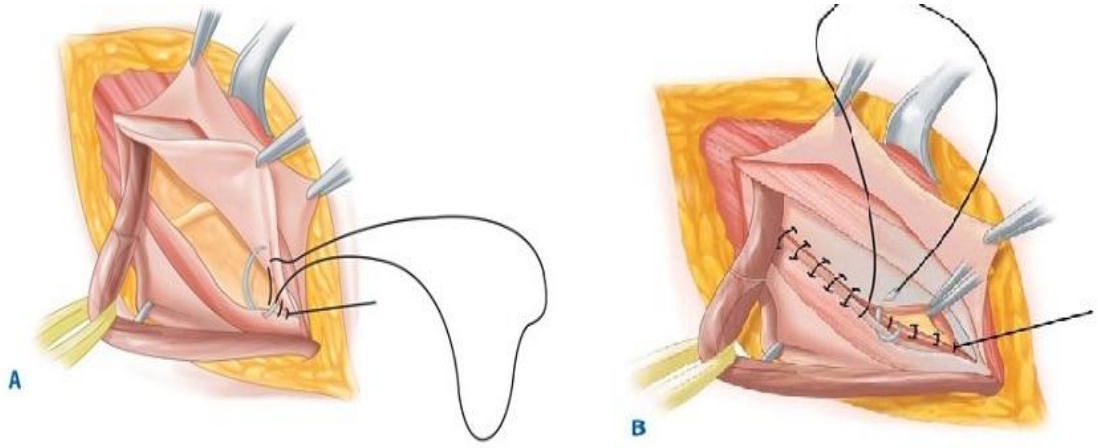
Figure 17: Bassinis repair

The Halsted procedure

William S. Halsted described this method in 1889. In many aspects it was performed like the Bassini method but the cord excised of its superficial veins and transposed to a position above the external oblique aponeurosis. He later modified his method and omitted the transposition of the cord and instead covered it with both the internal and external oblique muscles. After at least four years of follow-up, recurrence rate was 4%.

Shouldice repair[45,46]

The Shouldice technique is the most popular pure tissue hernia repair. In this technique the transversalis fascia is incised from the deep inguinal ring to medially as far as possible near pubic tubercle. The first layer of repair begins at the pubic tubercle where the iliopubic tract is sutured to the lateral edge of the rectus sheath, then progressing laterally. The inferior flap of the transversalis fascia, which includes the iliopubic tract, is sutured continuously to the posterior aspect of the superior flap of the transversalis fascia until the internal ring is encountered. The suture is not tied here, but rather is continued back upon itself in the medial direction. At the internal ring, the second layer is the re-approximation of the superior edge of the transversalis fascia to the inferior fascial margin and the shelving edge of the inguinal ligament. The suture is then tied to the tail of the original stitch. A third suture is started at the tightened inguinal ring, joining the internal oblique and transversus abdominis aponeuroses to external oblique aponeurotic fibers just superficial to the inguinal ligament. This layer is continued to the pubic tubercle where it reverses upon itself to create a fourth suture line.



The Shouldice repair. **A.** The iliopubic tract is sutured to the medial flap, which is made up of the transversalis fascia and the internal oblique and transverse abdominis muscles. **B.** This is the second of the four suture lines. After the stump of the cremaster muscle is picked up, the suture is reversed back toward the pubic tubercle approximating the internal oblique and transversus muscles to the inguinal ligament. Two more suture lines will eventually be created suturing the internal oblique and transversus muscles medially to an artificially created "pseudo" inguinal ligament developed from superficial fibers of the inferior flap of the external oblique aponeurosis parallel to the true ligament.

Figure 10: Shouldice repair

The Mcvay hernioplasty

Georg lotheissen first described this technique in 1898[47] but described again and popularized by Chester B. Mcvay[48] in 1941. The posterior wall was repaired by interrupted suturing. Medially the rectus sheet was adapted to cooper's ligament and laterally the transversalis fascia was adapted to the femoral sheath. By this both the femoral and the internal ring were narrowed. Mcvay recommended the use of this method for medial, femoral, large lateral and recurrent hernias. He reported a recurrence rate of less than 1% after 1-11 years of follow-up.[49]

The Lichtenstein hernioplasty

Irving Lichtenstein introduced the term tension-free hernioplasty[50] in the year 1986 and in 1987 he published a personal series of more than 6000 repairs[51] reporting a recurrence rate of 0.7%. At that time he recommended invagination of an indirect hernia sac and suturing of the transversus abdominis aponeurosis to the inguinal

ligament including narrowing of the internal opening medially to the cord and in case of a direct or recurrent hernia the posterior wall should also be reinforced by a mesh.

In 1989 Lichtenstein published his improved technique and nowadays often called original method[52] where he no longer performed a sutured repair of the posterior wall, he just reinforced it by bridging the defect with a mesh that was sutured with a continuous monofilament non absorbable suture. The method was further improved in the early nineties[53] with recommendations of larger, slightly relaxed mesh, medial mesh overlap, crossing and suturing of the tails of the mesh lateral to the cord and only interrupted absorbable sutures on the upper edge of the mesh.

As all popular methods, it has been further modified not only by Lichtenstein's successor amid[54] but also by many other surgeons. An ehs guideline published in 2009, states that it can be advisable to close a large direct hernia defect of the posterior wall, tension-free with continuous absorbable sutures until a flat posterior wall has been created with a normal internal ring.

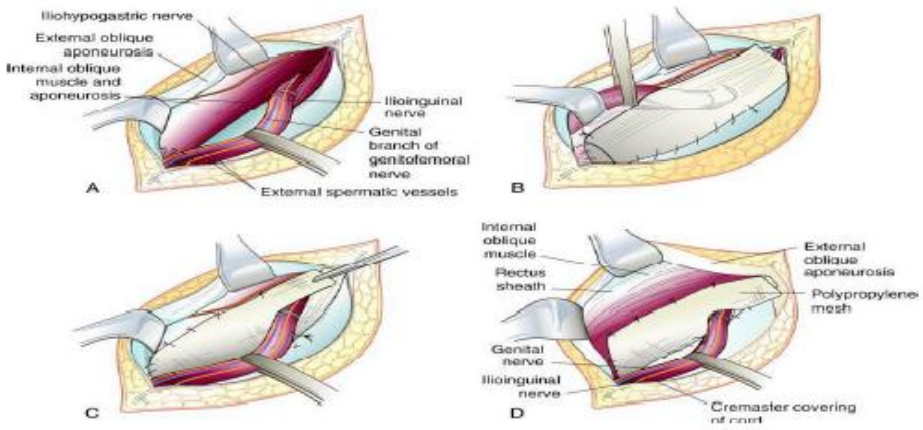


Figure 11: Lichtenstein repair.

Plug and Patch or Rutkow-Robbins technique

Alan Robbins and Ira Rutkow[55] described the plug technique in 1993. An umbrella shaped polypropylene plug was inserted into the hernia defect of the posterior wall acting as a sublay mesh and combined with an onlay flat mesh. They reported a recurrence rate of 1% for primary hernias on follow-up of upto to six years.

Open posterior mesh repairs

The Stoppa method[56]: the advantage of this operation is able to cure all types of hernias: primary as well as recurrences. In this technique the deep dissection of bogros' space identifies femoral hernias and any structures passing through the obturator orifice. The concept of a large preperitoneal mesh overlapping the peritoneum has been outlined by stoppa after rives. But the so-called stoppa operation by midline incision, gave the surgeon access to the entire bilateral myopectineal orifice of fruchaud and a large mesh could be inserted completely overlapping all inguinal and femoral orifices.

Nyhus modified posterior preperitoneal operation: Nyhus modified his original method[57] by applying a mesh in the preperitoneal space after repairing the defect in the transversalis fascia.[58] He recommended this procedure especially for recurrent hernias.

Endoscopic posterior mesh repairs IPOM (Intraperitoneal onlay mesh): in 1992 Charles Filipi described a laparoscopic technique in which a mesh is placed intraabdominal, covering all inguinal and femoral orifices.[59]

TAPP (Transabdominal preperitoneal repair): Maurice Arregui[60] described the method in 1992. By a transabdominal laparoscopic technique a preperitoneal mesh is placed covering all inguinal and femoral orifices.

TEP (Totally extraperitoneal repair): by Jean-Louis dulucq[61] described this technique in 1992. By the extraperitoneal laparoscopic technique a preperitoneal mesh is applied covering all inguinal and femoral orifices.

Complications of inguinal hernia surgery[72,73]

Nothing so prevents the occurrence of complications as one's awareness as well as fear of them. The complications cannot be eliminated altogether. They may be minimized by meticulous and precise surgical techniques.

Intra operative complications

• hemorrhage

• severance of nerves

• nerve-entrapment by sutures

• severance of testicular blood supply

• trauma to vas deferens

• damage to intestine

• injury to the bladder

• transection of spermatic cord

Post operative complications[73]

• general: systemic complications occur at a rate comparable with that after other surgical procedures of the same magnitude. Atelectasis and pneumonitis were most frequent followed by thrombophlebitis and urinary retention.

• scrotal ecchymosis.

• swollen testis

• ischemic orchitis and testicular atrophy

• hydrocele

• wound infection

• Recurrence[39,74]: a weakness in the operation area necessitating further operation.

There is no question that, both through anatomical knowledge and skilled technique are necessary for successful repair. Absence of tension in the completed hernial repair is essential to the success of repair recurrence, after 6 months are due to factors other than technical error or selection of inferior procedure[51]. Recurrence is also due to decreased collagen synthesis. Prevention of recurrence is done by supplementing the basic repair with additional support by prosthetic mesh. The overall recurrence reported is 10% for primary and 25% for recurrent inguinal hernia.

Others:

• urinary retention,

• neuroma,

• haematoma,

• seroma,

• sinus formation,

• sexual dysfunction.

Persistent post operative pain:

• groin pain. Common causes are nerve entrapment, neuroma, periostitis of pubic tubercle.

• numbness.

• paraesthesia.

Physiology and anatomy of chronic groin pain after inguinal herniorrhaphy [28,76,77]

Pain is defined as "an unpleasant sensory and emotional experience with actual or potential tissue damage or described in terms of such damage" by the international association for the study of pain.[98]

Chronic groin pain lasts >3 months.

Chronic groin pain can be nociceptive or neuropathic.

Nociceptive pain: nociceptive pain is a dull, burning, tugging, type of pain which is brought on by lifting or stretching. It is akin to ligamentus or tendon injury. It can be somatic or visceral in origin, and the nervous conducting system is intact. A lot of these patients have nociceptive pain from sutures or staples in ligamentous structures.

Neuropathic pain: neuropathic pain presents as a jabbing, electrical, or brief, sharp pain may be provoked by movement or it may occur spontaneously. There is an abnormality in conduction. Neuropathic pain is subdivided into three sub groups: peripherally generated, centrally generated, and sympathetically maintained.

Classic causes of chronic pain are osteitis pubis, and ilioinguinal nerve entrapment. The majority of chronic pain has been attributed to iloinguinal nerve entrapment. Postoperative pain is assessed using a 4- point verbal scale (none, mild, moderate, severe) assigning numerical values of 0 to 3.

Mild pain was defined as an occasional disturbance that did not limit normal activities. Moderate pain as pain that interfered with normal – day life activities.

Severe pain as pain that renderd the patient unable to perform normal activities.[97]

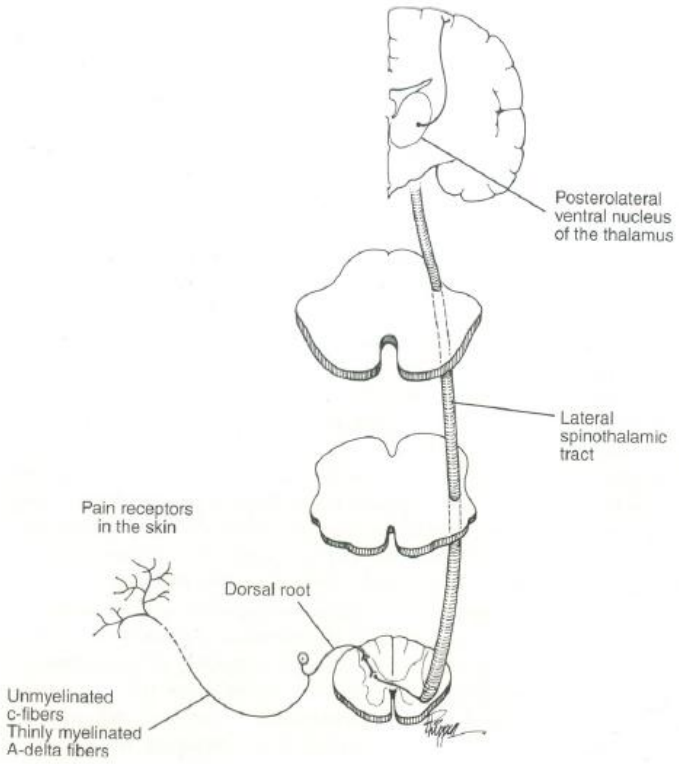


Figure - 12. Physiology of pain

Anatomic considerations

When the groin is explored via the anterior approach, one may encounter the ilioinguinal nerve, genital branch of genitofemoral nerve, and iliohypogastric nerve.

1. Ilioinguinal nerve (T12 – L1)

It emerges from behind the psoas along with or just inferior to the iliohypogastric nerve. It passes obliquely across the quadratus lumborum muscle, perforates the transvesus abdominus muscle near the anterior end of the iliac crest ,and then pierces the internal oblique muscle to run along the inguinal canal until it leaves by the external ring or by piercing the fascia just adjacent to the ring.

Function: it provides motor function to the internal oblique and sensory innervation to upper medial thigh, upper scrotum and root of the penis in males, mons pubis and labia majora in females.

-It is the nerve that is classically described as the primary cause of chronic pain.

Figure -13 – Ilioinguinal Nerve

2. Genitofemoral nerve (L 1– L 2)

It passes obliquely through the psoas muscle, exciting on the medial border of the L - 4 spinus process. It then passes behind the ureter and divids superior to the inguinal ligament. The genital branch follows the external iliac artery, passes through the internal ring into the inguinal canal and innervates the cremasteric muscle and scrotal skin in male or labia majora and mons pubis in female. Lateral femoral branch innervates anterolateral part of thigh.

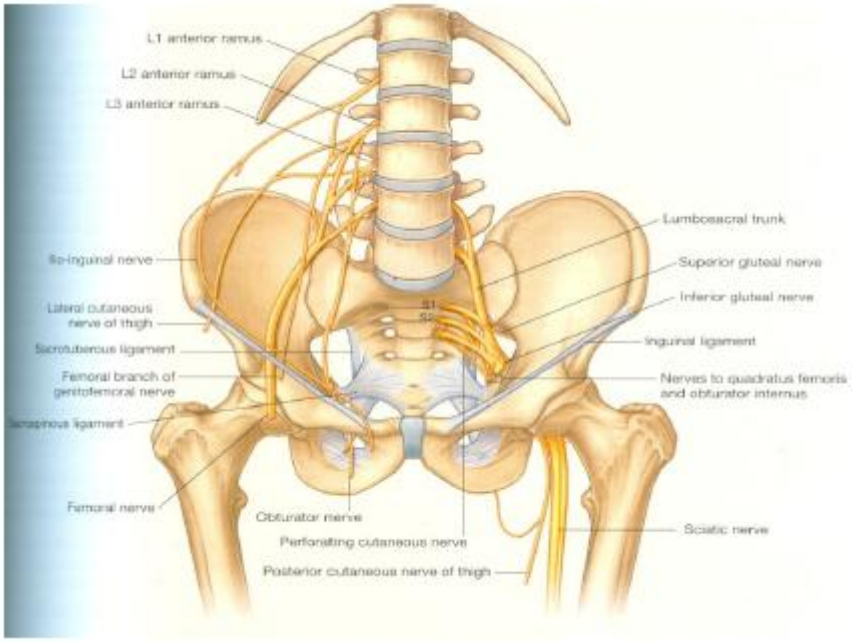


Figure-14- Lumbar plexus

3. Iliohypogastric nerve (T12 - L1)

It emerges lateral to the psoas muscle and runs in front of quadratus lumborum muscle. Above the iliac crest, it perforates the tranversus abdominus to provide the musculature with its innervation. Anterior cutaneous branch runs between the transversus abdominis muscle and internal oblique muscle until about 2 cm medial to the anterosuperior iliac spine, where it passes through the internal oblique muscle .It then proceeds medially and pierces the external oblique aponeurosis above the external ring. It innervates the suprapubic skin and gives branches to Ilioinguinal nerve.

Risk factors for chronic pain following herniorrhaphy[28, 77]

Preoperative pain may indicate complicated disease pathology prior to surgical intervention resulting in stretching, entrapment, or inflammation of inguinal nerves. It may also indicate the presence of psychological predisposition and lowered pain threshold among these patients, increasing potential for postoperative pain.

Direct injury to nerves that results in either partial or complete transection can lead to neuroma formation and contusion, crushing, cautery damage, suture compression can cause the subsequent development of chronic pain. Some have implicated the role of mesh as well. It has been demonstrated experimentally that when peripheral nerve tissue comes in contact with polypropylene mesh, myelin degeneration, edema, and fibrosis result and can lead to neuralgia and peripheral neuropathy.[78]

The implantation of mesh, which induces scar formation through increased inflammation, also has been suggested as a cause of neuropathic pain.

DIFFERENTIAL DIAGNOSIS OF CHRONIC GROIN PAIN

Dermatology • Lymphadenitis • Psoriasis/burn • Sebaceous cyst/ hioradenitis • Thrombophlebitis/ cellulites	Gynecology • C-section • Cervical cancer • Endometriosis • Tubal/ovarian disorders	Orthopedic Hip disorders • Acetabular labral tears • Avascular necrosis • Chondritis dissecans • Legge-Calve Perthes disease • Osteoarthritis • Pelvic stress fractures • Slipped femoral capsule epiphysis • Snapping hip syndrome • Synovitis	Surgery • Compensation (workman's) • Hernia • Recurrent hernia • Posthernia Open • Neuropathic • Non-neuropathic Laparoscopic • Neuropathic • Non-neuropathic
Infectious disease • Herpes zoster • HIV/tuberculosis • Lyme disease • Psoas abscess	Neurology • Lumbosacral disorders • Neurofibromatosis	Rheumatology • Connective tissue disease • Iliopsoas bursitis • Osteitis pubis • Systemic lupus eritematous	Urology • Cystitis • Epididymitis • Nephrolithiasis • Prostatitis • Torsion of testes • Urethral extravasation • Urinary tract infection • Vas granuloma/ fibrosis
Gastroenterology • Appendicitis/ adhesions • Diverticulitis • Inflammatory retroperitoneal phlegmon (pancreatitis) • Meckel diverticulitis • Granulomatous colitis	Neurosurgery • Disc disease • Spinal injuries, inflammation, tumors • Spondylosisthesis • Spondylolysis	Sports medicine • "Sports hernia" (adductor strains) • Gilmore's groin	Vascular • Abscess hematoma • Postvein stripping • Pseudoaneurysm • Vascular graft

Avoiding Chronic Pain Following Inguinal Herniorrhaphy[28,62,86]

Judicious clinical judgment advocate early intervention with careful dissection to avoid preventable nerve injury, thereby minimizing this potential debilitating morbidity. Care must be taken to avoid placement of sutures at the medial insertion of the inguinal ligament to avoid excessive tightness of the inguinal ligament at pubic tubercle. Avoiding indiscriminate division of subcutaneous tissue. Avioding removal of the cremastic muscle fibres. Avoiding placement of sutures in the lower edge of the internal oblique muscle, and avoiding making the external ring too tight.

A study performed by Lichtenstein that investigated prevention of post herniorrhaphy neuralgia proposed that transection of ilioinguinal and genitofemoral nerve prove to be a useful solution.

A double blinded, RCT trial to investigate the effects of prophylactic ilioinguinal neurectomy following tension free mesh repair of inguinal hernia was conducted with 100 male patients, randomized into two groups: prophylactic ilioinguinal neurectomy or ilioinguinal nerve preservation. The findings demonstrated that the incident of chronic pain at 6 months was significantly lower compared with the nerve preservation group (8% versus 28.6%, p=.0008). And no significant difference was found in the incidence of neurosensory complaints, including groin numbness and sensory loss. However, it has been postulated that the sensory loss that may result following prophylactic neurectomy might be compensated for by cross innervations provided by cutaneous nerves from the contralateral side and, therefore the morbidity following neurectomy would be negligible.[62]

The cooperative hernia study assessed postoperative pain in a prospective trial as part of a larger study looking at the recurrence rate and other morbidity of the Bassini, McVay and Shouldice repair. Just over three hundred patients were randomized to one of the repairs. At two years 50% of patients had some degree of pain and 10% had moderate to severe pain. They concluded that the predictors of long term post operative pain include, absence of visible bulge preoperatively, numbness in the immediate postoperative period and the need for the patient to spend 36 weeks or more off work postoperatively.[87]

Intraoperative nerve damage and disposition to other chronic pain conditions are the most likely pathogenic factors. Chronic pain post inguinal hernia repair ranges from 0 – 63% and is usually broadly classified into three categories mild, moderate

and severe. Severity may be determined by extent of interference with social, daily and work related activities, number of painkillers used and attendance at chronic pain clinics. Perkins looked at post herniorrhaphy pain in the context of their chronic pain model and estimated that it may be as high as 50% at one year.[88] They believe that the presence and extent of preoperative pain may influence the degree of postoperative pain. Some authors would argue that it is not imperative to repair all hernias as soon as they are detected. In the context of postoperative chronic pain there is a defined point where the surgeon must intervene, quantifying this point however is not clear. Repair of recurrent hernia and type of mesh used may be related to long-term chronic postoperative pain.

As many as 66% report pain at the time of initial presentation and this increases to 90% in those patients that have their hernia for 10 years or more.[89] What degree of preoperative pain needed to make repair worthwhile is not clear. For the patient to believe that the surgical experience has been worthwhile, the reduction in preoperative symptoms has to be greater than the risk of severe postoperative chronic pain and more than chronic pain per se. Arguments supporting repair are based on alleviating symptoms and avoiding the risk of an acute hernia accident, the latter being often estimated at between 4 and 6%.[90] However because large population based studies detailing the natural course of an untreated hernia are scarce, this commonly held assumption that the life time risk of strangulation is between 4 and 6% is more likely one of speculation than fact.

Ducic et al believe that severe and chronic postoperative testicular pain after inguinal surgery can be treated by a designed approach that identifies the genital

branch of the genitofemoral nerve in the proximal inguinal canal, resect it proximal to the previous operative field and subsequently places it behind the peritoneum.[91]

Al-Dabbagh et al reviewed the anatomical variations in the course of the ilioinguinal and iliohypogastric nerves in 110 hernia repairs.[92] They found that the course of both nerves was consistent with that found in anatomical textbooks in just fewer than 50% of cases. This difference in the variation of the nerve along its pathway may leave it susceptible to injury at operation. However these differences in the course of the nerves can be readily appreciated and should be easily identified by the surgeon.

Since the early 1980's peripheral nerve entrapment syndrome following common surgical procedures to the lower abdominal wall have been recognized. Ilioinguinal or iliohypogastric nerve entrapment is typically diagnosed as a burning pain near the incision that radiates to the area supplied by the nerve with associated impaired sensory perception. Resolution occurs, albeit temporarily, when the two nerves are infiltrated with local anaesthetic as they leave the internal oblique. Surgical repair of the scar and resection of the nerve was advocated as the method of treatment for this condition.[93]

In 1996 Bower et al reported that severe chronic postoperative inguinal hernia neuralgia was rare. They suggested that in the small number of patients in whom non operative methods of treatment were refractory, the involved nerve should be mapped out prior to its surgical high ligation and division.[94]

Understanding the typical nerve anatomy and variation, is fundamental in treating this rare but debilitating postoperative complication. A larger series of just under 500 patients, this time confining the surgical procedure to the sutured Shouldice

repair of an inguinal hernia, states that inguinal entrapment syndrome can be reduced to below 2% if the genital branch of the genitofemoral nerve is deliberately dissected free or cut cleanly.[95]

Dittrick et al reviewed 90 patients who underwent Lichtenstein inguinal hernia repair over a seven year period. The two surgeons who performed the operations differed in the fact that one preformed ilioinguinal neurectomy on a routine basis. Neuralgia and paraesthesia were assessed through telephone and personal patient interviews at 1 month, 6 months, 1 year and 3 years post surgery. They concluded that the incidence of postoperative neuralgia was significantly lower in the neurectomy group versus the nerve preservation group at 1 month and 1 year but there was no significant difference in postoperative neuralgia at 3 years, though they did admit that numbers followed up at 3 years were small. At the same time the incidence of postoperative paraesthesia was not significantly higher in the neurectomy group versus the nerve preservation group at 1 month, 1 or 3 years. Those that reported postoperative paraesthesia in the neurectomy group at one month and six months had lower mean scores on the visual analogue scale than those in the nerve preservation group. These authors argue that routine division of the ilioinguinal nerve is a reasonable option during inguinal hernia repair.[96] The drawback of this study was that it was retrospective and that small numbers of patients were used.

Recently a double blind randomized controlled study was published in the Archives of Surgery from Italy. In four centres, 813 patients were randomized to inguinal hernia repair with either preservation or elective transection of the ilioinguinal nerve. The primary outcome was chronic pain at one year. At one year pain was absent in 76% of those with nerve preservation and in 73% of those with

nerve transection. The majority of patients that reported pain had mild to moderate pain. However at 1 and 6 months postoperatively loss of pain and touch sensation were significantly greater in the group with the ilioinguinal nerve transected. Touch sensation remained decreased in the group with nerve transection even at one year follow up.[97]

In a second Italian study the identification and preservation of all three nerves during open mesh repair was associated with a reduction in chronic incapacitating groin pain and in the majority of these patients with chronic pain at six months the pain was resolved with conservative or medical management at 1 year.[98]

Madura et al state that the incidence of post herniorrhaphy neuropathies is not well known but is estimated to be in the region of 0 to 30%.[14] They argue that the most successful treatment is surgical resection of the nerve with good pain relief. Complete pain relief was seen in 72% of patients in their study and 10% reported a marked decrease in their symptoms. The only difference between patients who had complete relief and those who had partial relief of their symptoms was previous repair of a recurrent hernia. This seems to be the only available indirect evidence of chronic pain post repair of a recurrent inguinal hernia. To date there are no available studies that look at the incidence of post herniorrhaphy pain in patients who have had recurrent hernias repaired. One would assume that there is a higher incidence of chronic pain in these patients as tissue and nerve damage is twice as likely second time round. As an indirect result of our first study we found that patients who had a recurrent hernia repaired were no more likely to report pain at three months post surgery than those who had a primary hernia repaired. Therefore one can argue that chronic postoperative pain is partly explained by nerve damage at initial surgery.

When any of the nerves are not recognized and as a result traumatized, chronic postoperative pain can ensue. However it would appear that the situation is not clear. While cleanly dividing the nerves does not exacerbate postoperative pain it does play a role in disturbed sensory changes after repair. On the other hand clean nerve division can also be a solution for severe chronic neuropathic pain. It has been postulated that when these nerves are caught or trapped in permanent stitches or tacks or bound up in the mesh during the various methods of repair it is then that postoperative chronic neuropathic pain may result.

Evaluating and Treating the Chronic Pain. [14,60 – 68,91] Causes of chronic pain following inguinal herniorrhaphy can be divided into neuropathic and non neuropathic etiologies. The most common non neuropathic causes include hernia recurrence, excessive scar formation, and pressure from the bulk of the mesh. The neuropathic etiologies of chronic pain include nerve entrapment by sutures or staples and neuroma formation with partial and complete transection of the nerve.

Neuropathic pain related to the genitofemoral nerve may result in testicular pain in men and labial pain in women. In these patients thorough urological evaluation aimed at identification underlying testicular or epididymal pathology in men and careful gynecological examination in women is also necessary.[91]

Ultrasound is another potential diagnostic modality to help determine occult recurrences. [65] MRI also been used to detect recurrence, delineate mesh position, and demonstrate non hernia related causes of pain. [66]

By physical examination one can specifically elicit ilioinguinal nerve entrapment by having the patient hyperextended and twist the trunk of the body on opposite side of hernia repair.[14]

Treatment modalities include:

1. Oral analgesics

2. Regional nerve blocks

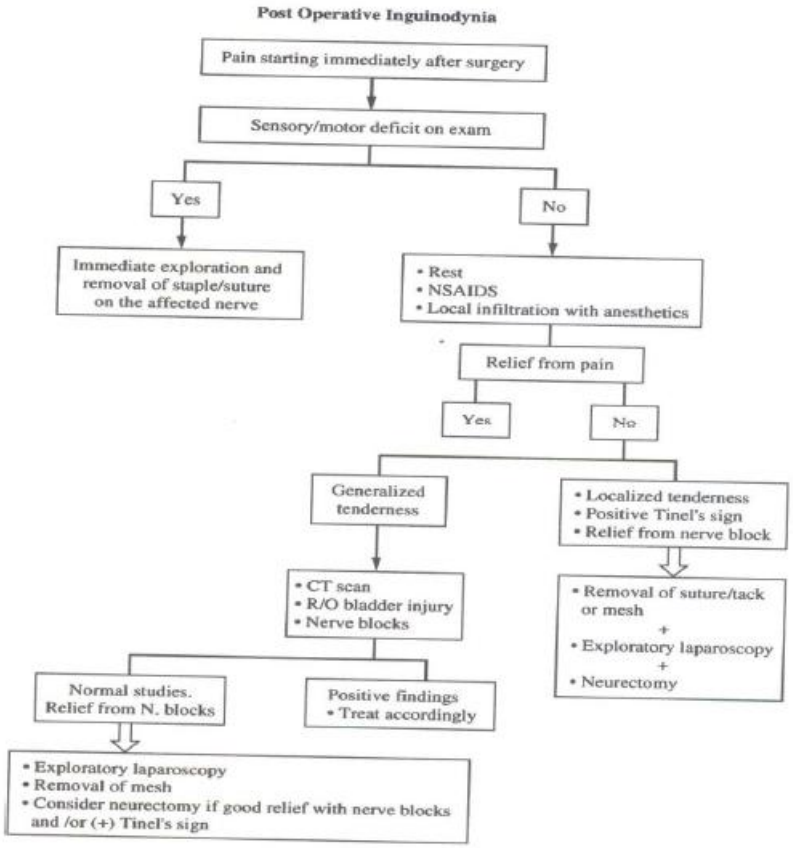
3. Re-operation with mesh extraction, and

4. Surgical neurectomy: the best surgical option to date may in fact be exploration with neurectomy and possible mesh removal.

On a reported series of 54 patients who underwent groin exploration with triple neurectomy that included the ilioinguinal, iliohypogastric, genitofemoral nerves, 68% were relieved of pain.

This was confirmed in another study, which demonstrated that triple neurectomy resulted in a 72% complete pain relief 25% partial relief.[14]

ALGORITHM OF TREATING CHRONIC GROIN PAIN [63, 68]



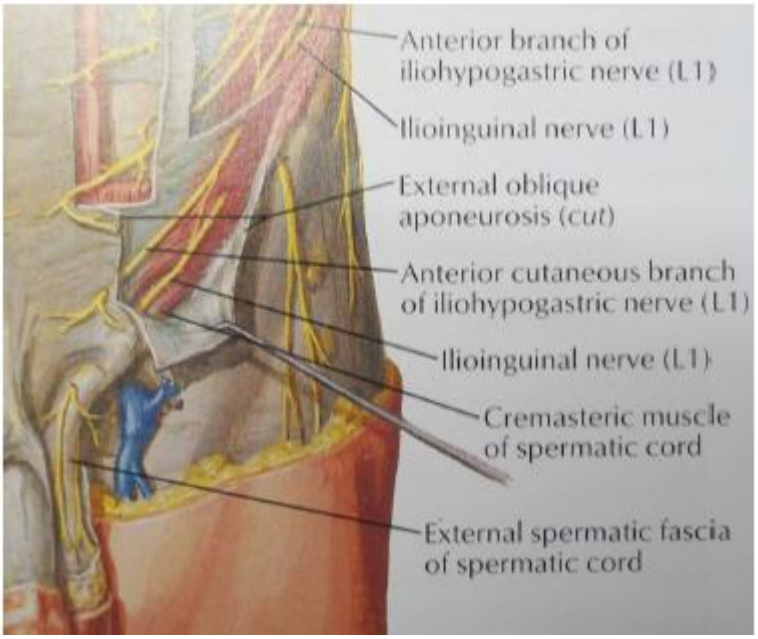


Figure - 15. Nerves in relation to Groin

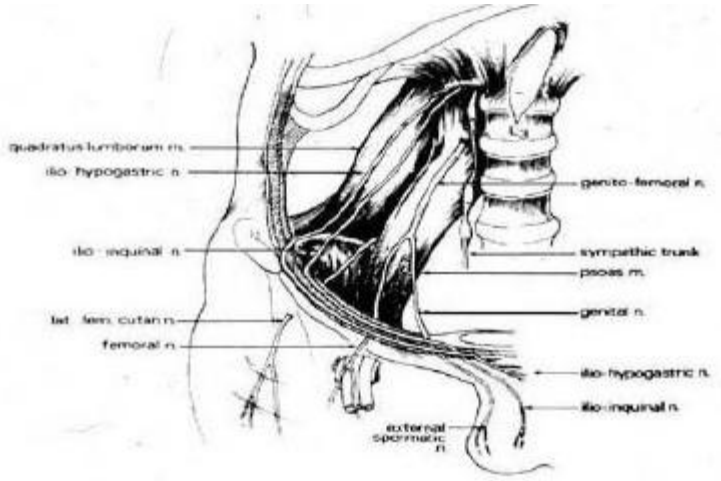


Figure -16. Course of Ilioinguinal Nerve

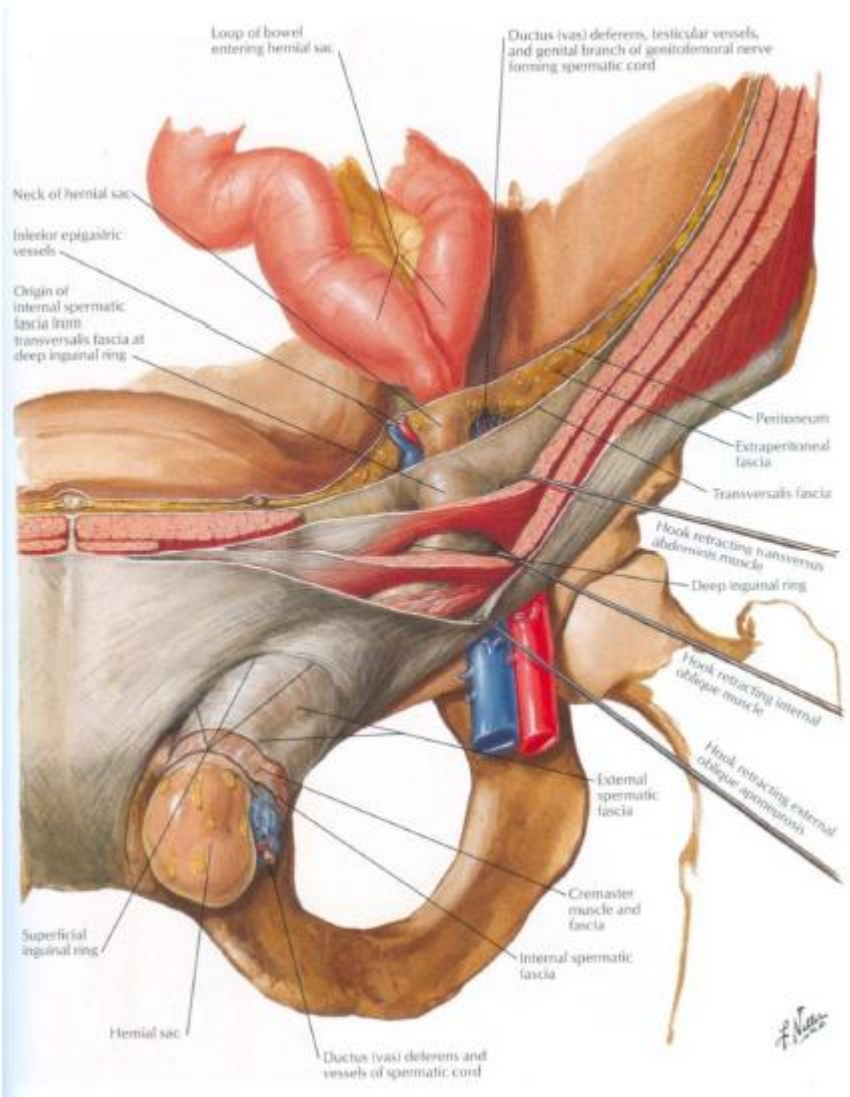


Figure -17. Hernial sac with Indirect Component

Chapter 4

Methodology

METHODOLOGY

This one year randomized controlled trial was conducted in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum over a period, from January 2016 to December 2016.

Study design

The study design was single blinded randomized controlled trial.

Study period and duration

This study was conducted for the period of one year from January 2016 to December 2016.

Place

This study was done in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum attached to KLE University's Jawaharlal Nehru Medical College, Belgaum.

Source of Data

Patients admitted with primary uncomplicated inguinal hernia requiring mesh repair under Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum were studied.

Sample size

A total of 80 patients divided into two groups of 40 each were studied.

Sampling procedure

Computer generated random numbers will be used to assign the type of surgery to the patients that is, group A (patients undergoing elective division of ilioinguinal nerve) and group B (preserving of ilioinguinal nerve) in Lichtenstein inguinal hernia repair , Patients will be blinded to the intervention. The sample size was taken as 80, with 40 in each group by applying the formula,

$$n = \frac{2(Z\alpha + Z\beta)^2 PQ}{(P_1 - P_2)^2}$$

where $Z_\alpha = 1.96$

$Z_\beta = .84$

$P_1 = 18\%$

$P_2 = 0\%$

$\alpha = .05$

$\beta = .2$

$$P = \frac{P_1 + P_2}{2} \qquad q = 100 - P$$

n=40(sample size in each group)

Selection criteria

Inclusion

1) Patients who are undergoing Lichtenstein inguinal hernia repair in KLE Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi and those who give written and informed consent for participation in study

2) Primary uncomplicated Inguinal hernia

3)18-80 years of age

Exclusion

1) subjects with reccurent hernias

2) Subjects with chronic cough and wound infection

3) immunocompromised individuals

4) Previous groin surgeries

5) complicated hernias

6) Patients having urinary symptoms (lower uterine tract symptoms)

Ethical clearance

The study was approved from the Ethical and Research Committee, Jawaharlal Nehru Medical College, Belgaum prior to the commencement.

Informed Consent

The patients fulfilling selection criteria were informed in detail about the nature of the study, especially the benefits of elective excision of ilioinguinal nerve over preservation of ilioinguinal nerve in Lichtenstein mesh repair and a written informed consent was obtained (Annexure I).

Randomization

The patients were randomized by computer generated random numbers which were used to assign the type of surgery; the patients were divided into two groups of 40 each as below;

- Patients undergoing elective division of ilioinguinal nerve in lichtenstein mesh repair formed group A [study group].

- Patients undergoing preservation of ilioinguinal nerve in Lichtenstein mesh repair formed group B [control group].

Method of collection of data

Demographic data such as age, sex and history was obtained through an interview. Details such as duration, lump size were noted. These patients were subjected to clinical examination and the findings such as size, cough impulse, position were noted on a predesigned and pretested proforma (Annexure II).

Investigations

The following tests were subjected to the following investigations.

- Routine blood counts – Hemoglobin, total leucocyte counts, differential counts, red blood cell counts and ESR.
- Blood urea nitrogen, Serum creatinine, RBS.
- Bleeding and clotting time.
- Urine Routine and Microscopy.
- Chest X-ray and ECG.
- Ultrasonography- to rule out BPH.
- viral markers(HIV & HbsAg).

Surgical procedure

In this group the skin and subcutaneous tissue was incised. The external oblique aponeurosis was opened. The cord was identified and the indirect sac if present was ligated and pushed inside. The ilioinguinal nerve was identified. In Group A patients undergo elective division of ilioinguinal nerve and in Group B patients undergo

preservation of ilioinguinal nerve with care. The floor was reinforced with flat polypropylene mesh (7 x15 cm) and was sutured to the pubic tubercle and a continuous suture was taken to fix the mesh to the reflected part of the inguinal ligament. Mesh was fixed to the conjoint tendon by interrupted sutures. A slit was created for the cord structures and internal ring is recreated. Mesh is overlapped and fixed. The external oblique aponeurosis was closed. The subcutaneous tissue and skin was closed.

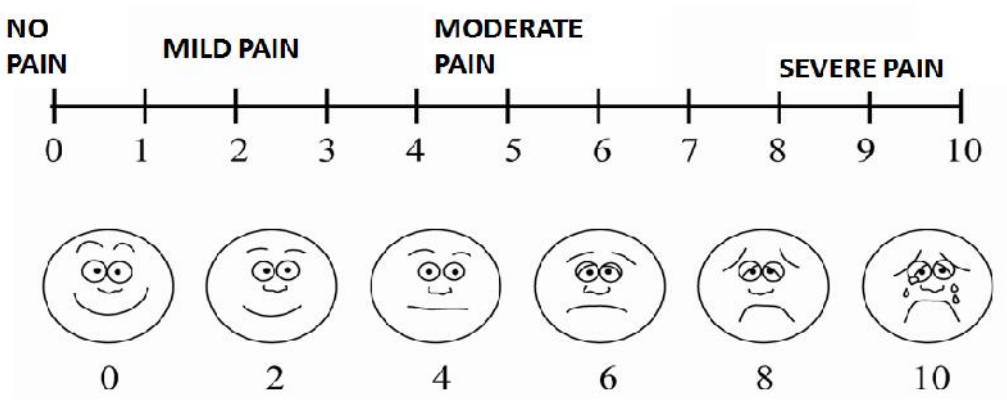
Pain management

Post operatively patients of both the groups were given the same analgesics that is, Injection Diclofenac 50mg IM BD. Later oral diclofenac 50mg was given as per requirement.

Outcome variables

Pain was assessed based on Visual Analogue Score ranging from 0 to 10 considering 0 as no pain and 10 as maximum pain. Further the pain was divided into 3 categories.

- Mild – VAS score ≤ 3
- Moderate – VAS score between 4 to 6
- Severe – VAS score ≥ 7



Follow up

Patients were followed up at following intervals;

- Postoperative day1
- Postoperative day3
- Post operative 1week
- 4 weeks follow up
- 3 months follow up

Statistical analysis

The data obtained was coded and entered in Microsoft Excel Spreadsheet. The categorical data was expressed as rates, ratios and percentages and comparison was done using Mann whitney test and‘t’ test. Continuous data was expressed as mean ± standard deviation. A ‘p’ value of less than or equal to 0.05 was considered as statistically significant.

Chapter 5

Results

RESULTS

The present one year randomized controlled trial was conducted in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi from January 2016 to December 2016.

A total of 80 patients admitted with inguinal hernia requiring mesh repair were included in the study. These patients were further randomized into two groups of 40 each as below;

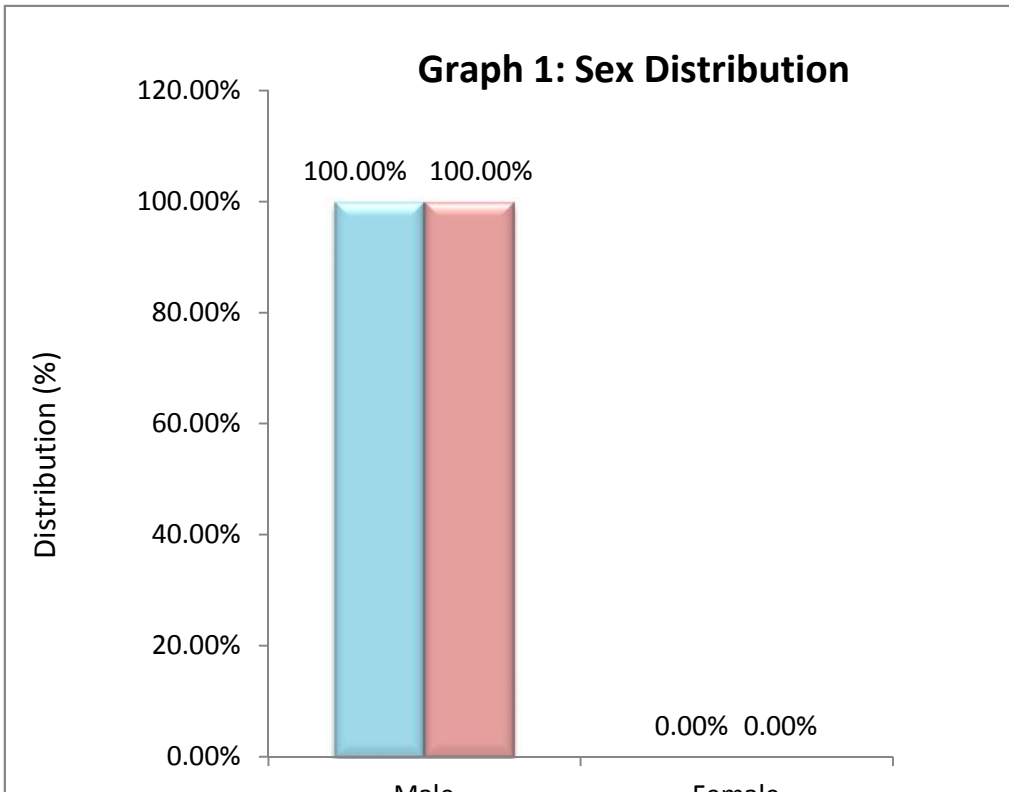
- Patients who underwent elective division of ilioinguinal nerve in lichtensteins hernia repair formed group A.
- Patients who underwent lichtensteins hernia repair in whom ilioinguinal nerve is preserved formed group B.

The data obtained was coded and entered in Microsoft Excel Spreadsheet. The data was analysed and the observations were tabulated as below.

Table 1. Sex distribution

Sex	A (n=40)		B (n=40)	
	Number	**Percentage**	**Number**	**Percentage**
Male	40	100.00	40	100.00
Female	0	0.00	0	0.00
Total	**40**	**100.00**	**40**	**100.00**

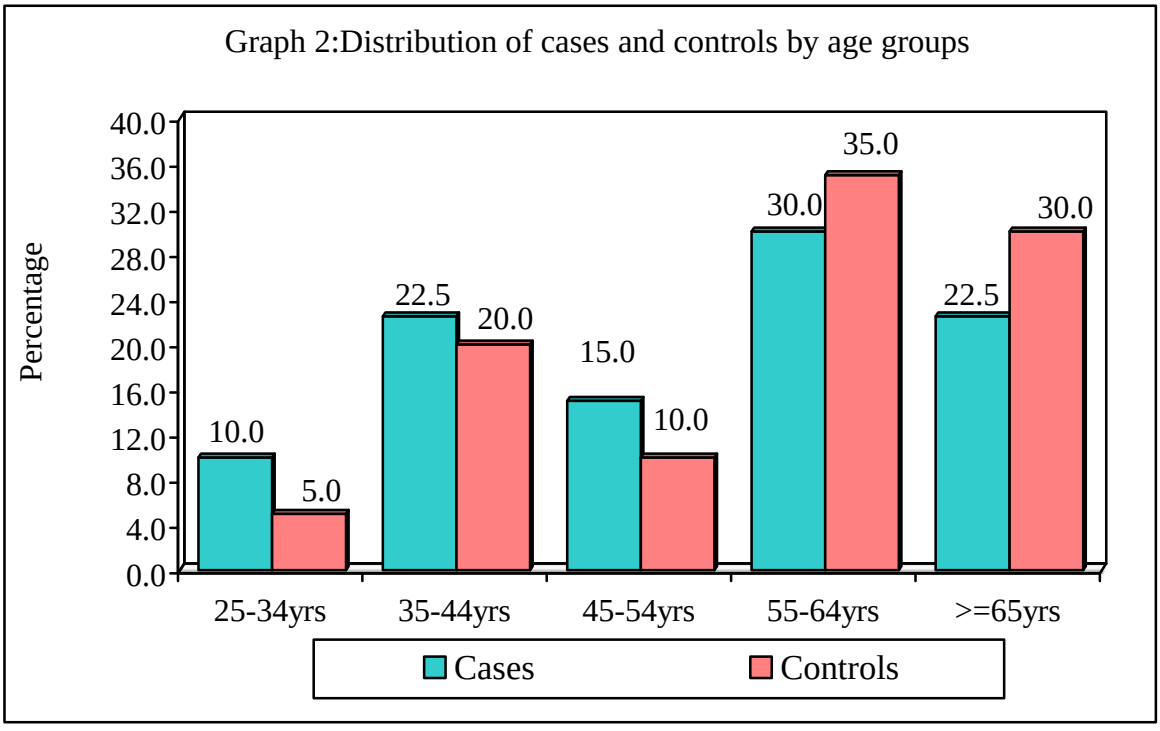
p=1



In the present study, all the patients in group A and group B were males.

Table 2: Distribution of cases and controls by age groups

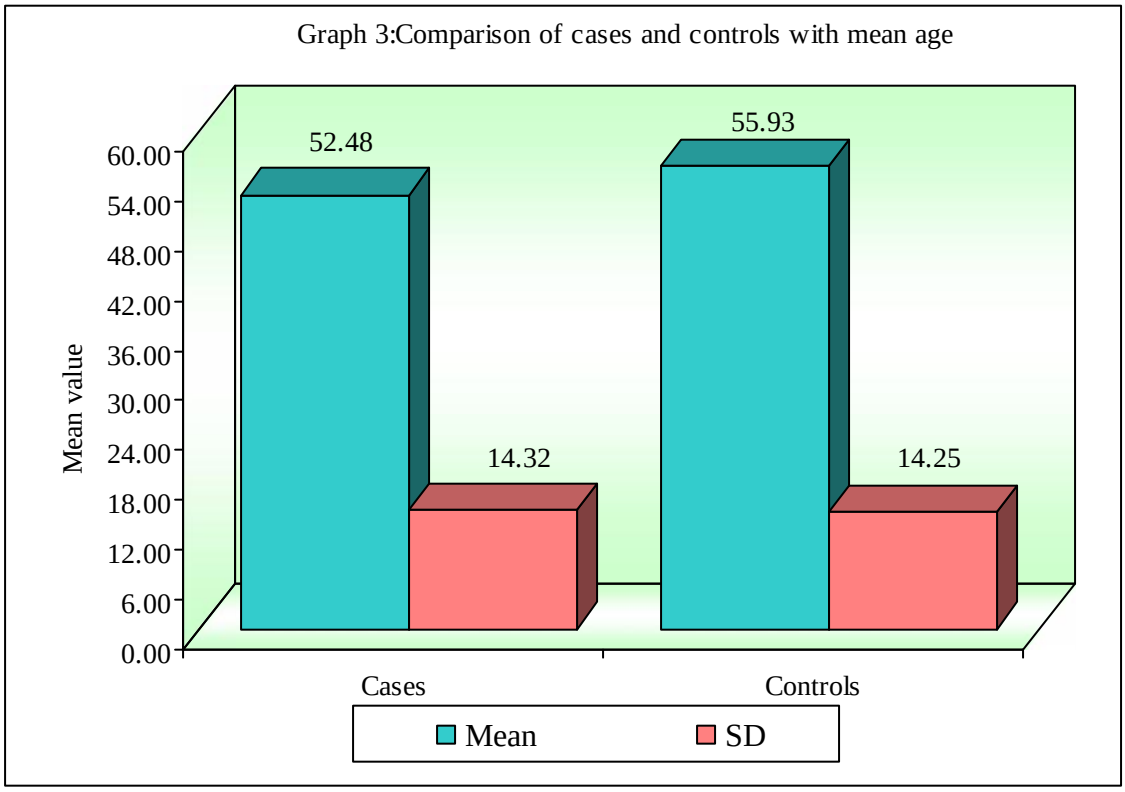
Age groups	Cases	%	Controls	%	Total	%
25-34yrs	4	10.00	2	5.00	6	7.50
35-44yrs	9	22.50	8	20.00	17	21.25
45-54yrs	6	15.00	4	10.00	10	12.50
55-64yrs	12	30.00	14	35.00	26	32.50
>=65yrs	9	22.50	12	30.00	21	26.25
Total	40	100.00	40	100.00	80	100.00
Chi-square=1.7082 P = 0.7891						



In the present study, distribution of age groups in group A(cases) and group B(controls) are 10% vs 5% between 25-34yrs,22.5% vs 20% between 35-44yrs,15% vs 10% between 45-54yrs,30% vs 35% between 55-64yrs,and 22.5% vs 30% in >=65yrs respectively are comparable.

Table 3: Comparison of cases and controls with mean age by t test

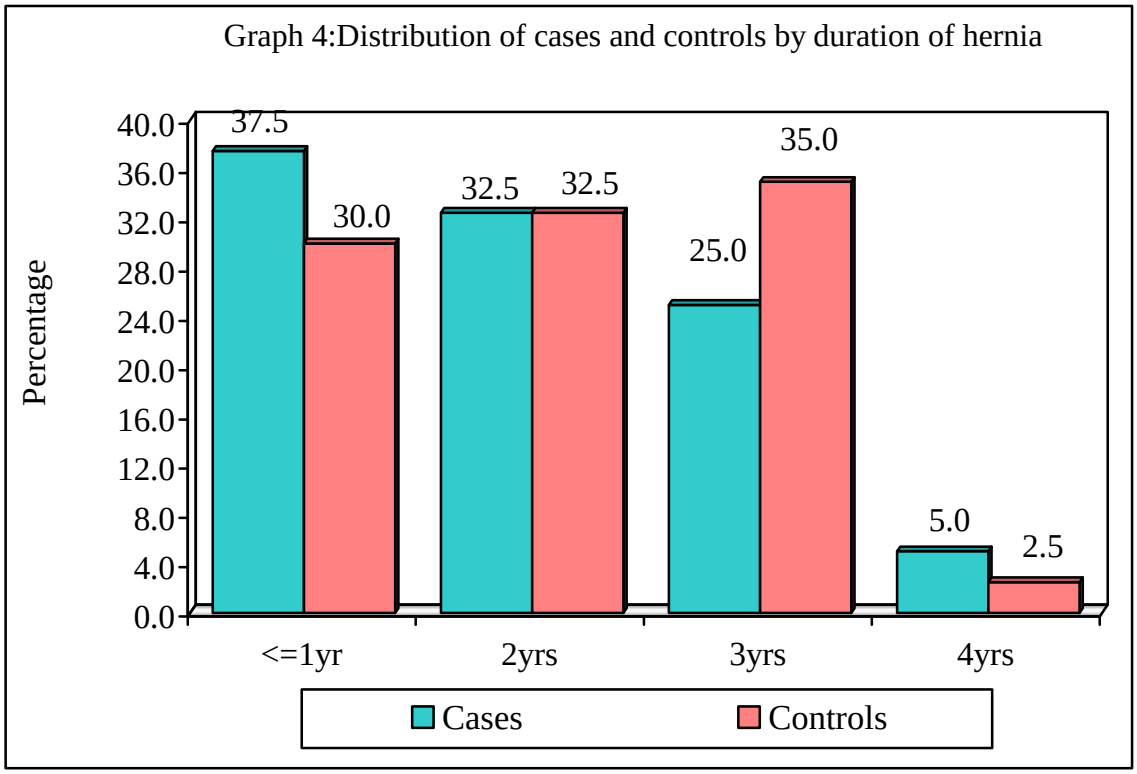
Groups	Mean	SD	SE	t-value	P-value
Cases	52.48	14.32	2.26	-1.0798	0.2836
Controls	55.93	14.25	2.25		



In the present study, the mean age in group A was 52.48 ± 14.31 years compared to 55.93 ± 14.25 years in group B, the youngest patient being 25 years of age. However the difference was statistically not significant (p=0.2836).

Table 4: Distribution of cases and controls by duration of hernia

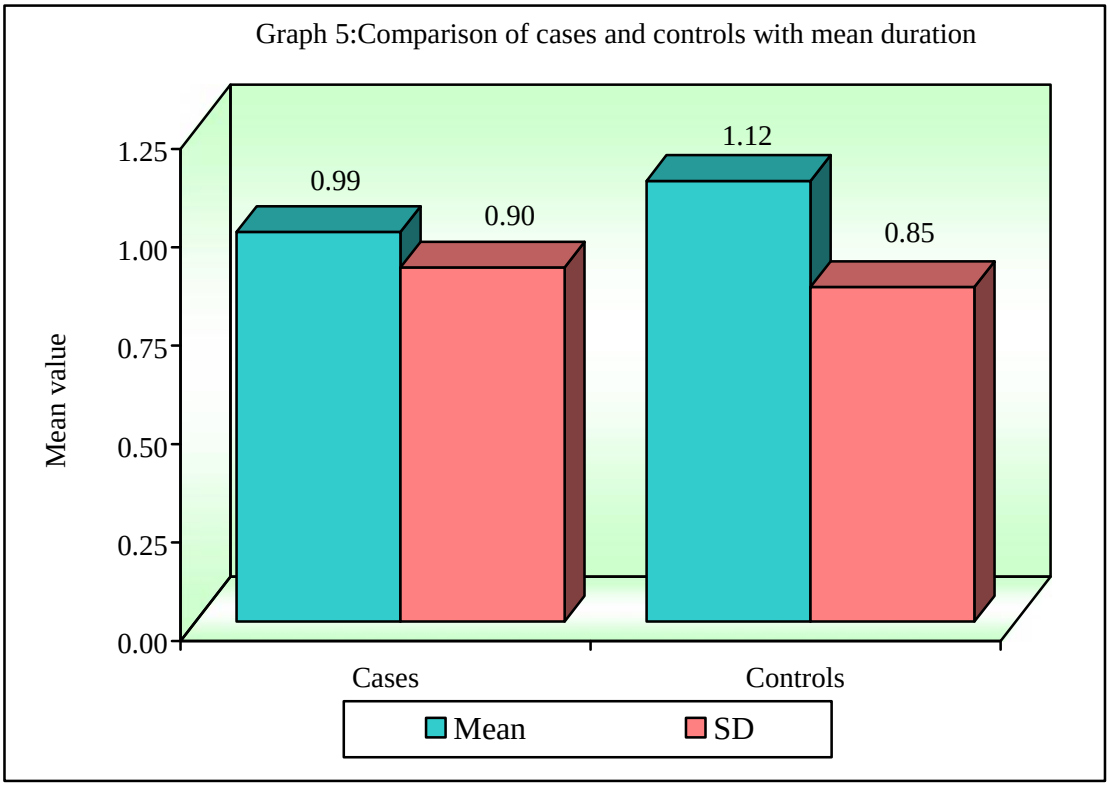
Duration	Cases	%	Controls	%	Total	%
<=1yr	15	37.50	12	30.00	27	33.75
2yrs	13	32.50	13	32.50	26	32.50
3yrs	10	25.00	14	35.00	24	30.00
4yrs	2	5.00	1	2.50	3	3.75
Total	40	100.00	40	100.00	80	100.00
Chi-square=1.3333 P = 0.7212						



In the present study, the duration of hernia in group A and group B was 37.50% vs 30% since <= 1yr,32.50% vs 32.50% since 1-2yrs,25% vs 35% since 2-3yrs,5% vs 2.50% 3-4 yrs respectively.

Table 5: Comparison of cases and controls with mean duration by t test

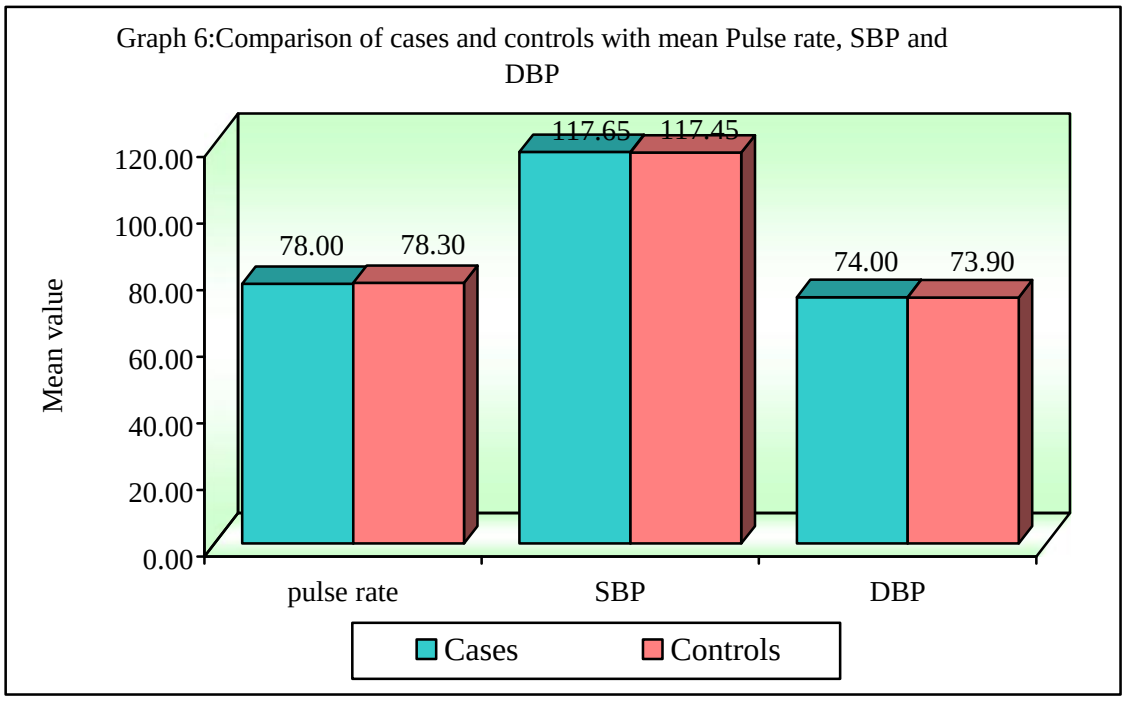
Groups	Mean	SD	SE	t-value	P-value
Cases	0.99	0.90	0.14	-0.6256	0.5334
Controls	1.12	0.85	0.13		



In the present study the mean duration of the disease was 0.99 ± 0.90 years in group A whereas in group B it was 1.12 ± 0.85 years. However, this difference was not statistically significant (p=0.5334).

Table 6: Comparison of cases and controls with mean Pulse rate, SBP and DBP by t test

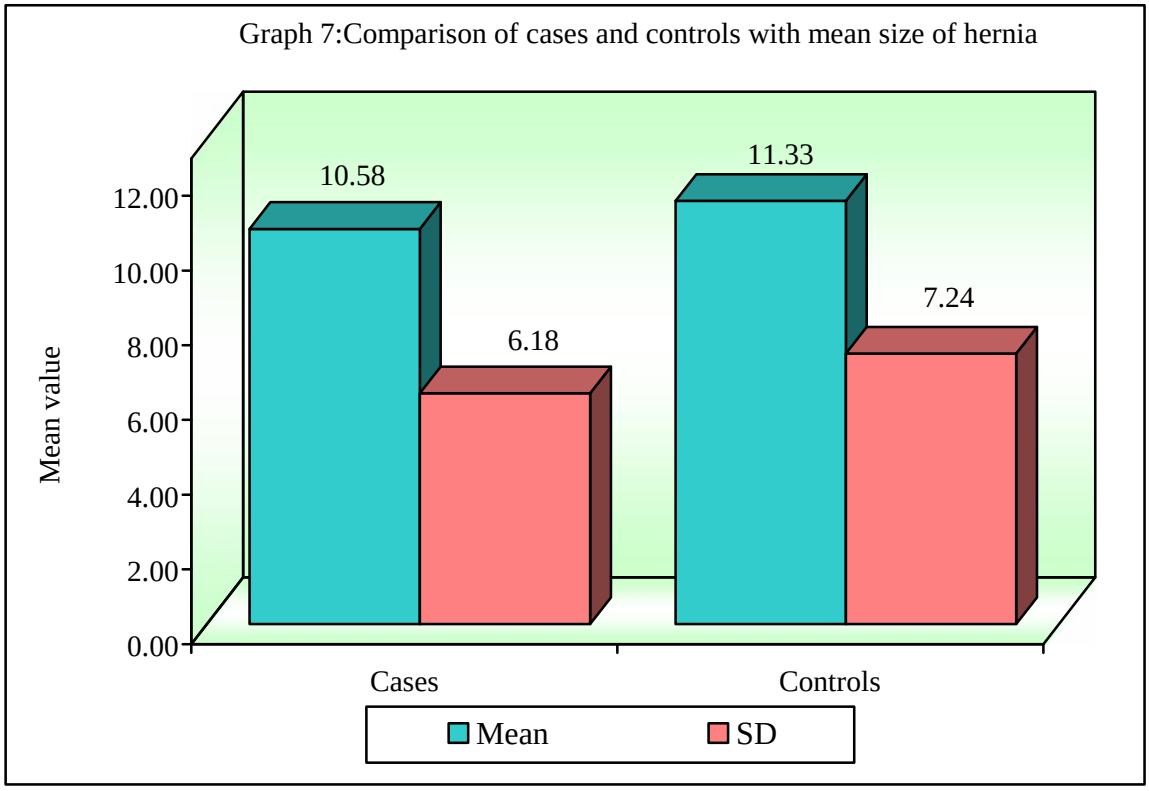
Variable	Groups	Mean	SD	SE	t-value	P-value
Pulse rate	Cases	78.00	5.12	0.81	-0.2626	0.7936
	Controls	78.30	5.09	0.81		
SBP	Cases	117.65	8.76	1.38	0.0971	0.9229
	Controls	117.45	9.65	1.53		
DBP	Cases	74.00	5.18	0.82	0.0863	0.9315
	Controls	73.90	5.18	0.82		



In this study, the mean pulse rate in group A and group B (78.00 ± 5.12 vs 78.30± 5.09 /min; p=0.7936), systolic blood pressure (117.65 ± 8.76 vs 117.45 ± 9.65 mm Hg; p=0.9229) and diastolic blood pressure (74.00 ± 5.18 vs 73.90 ± 5.18 mm Hg in both; p=0.9315) were comparable.

Table 7: Comparison of cases and controls with mean size of hernia by t test

Groups	Mean	SD	SE	t-value	P-value
Cases	10.58	6.18	0.98	-0.4983	0.6197
Controls	11.33	7.24	1.14		

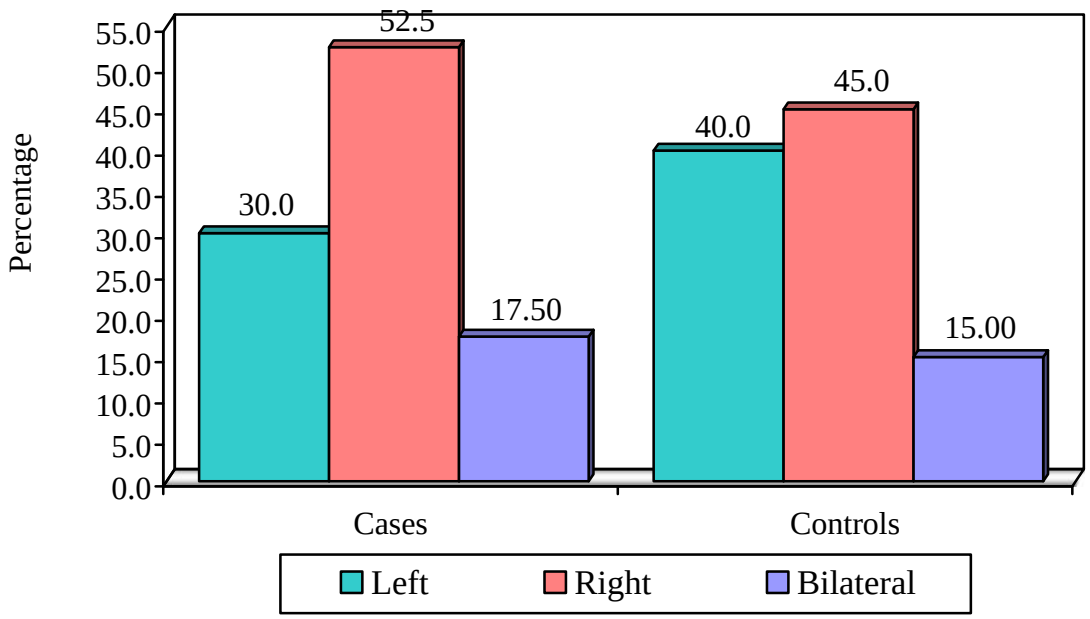


In the present study the mean size of the hernia swelling was 10.58 ± 6.18 square centimetres in group A whereas in group B it was 11.33 ± 7.24 square centimetres. However, this difference was not statistically significant (p=0.6197).

Table 8: Comparison of cases and controls by side of hernia

Positions	Cases	%	Controls	%	Total	%
Left	12	30.00	16	40.00	28	35.00
Right	21	52.50	18	45.00	39	48.75
Bilateral	7	17.50	6	15.00	13	16.25
Total	40	100.00	40	100.00	80	100.00
Chi-square=0.8792 P = 0.6442						

Graph 8:Comparison of cases and controls by side of hernia

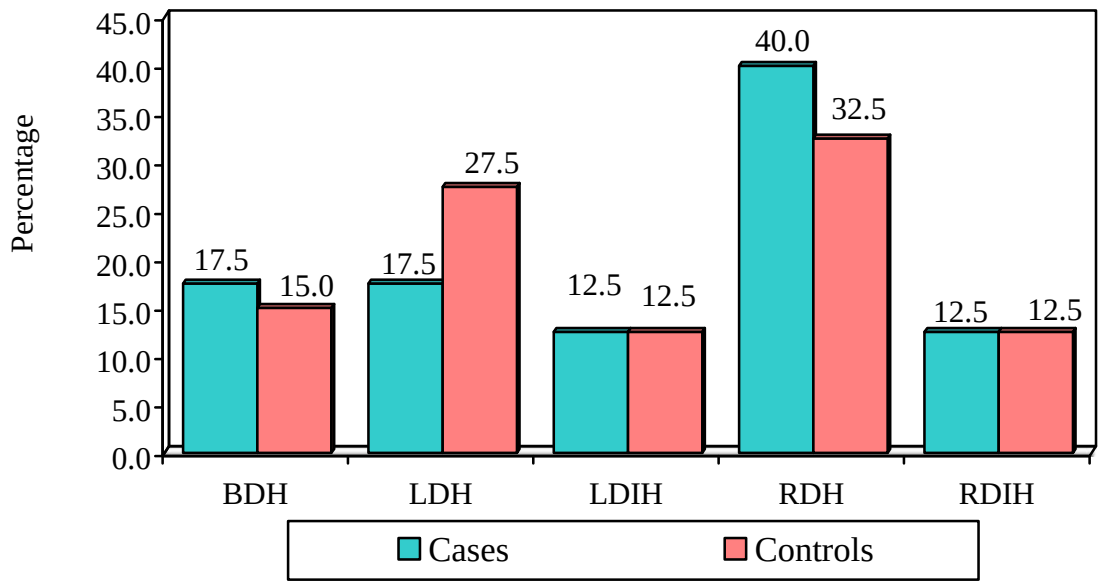


In the present study, 52.50% of patients in group A presented with a right-sided swelling compared to 45.00% of patients in group B. 30% of patients in group A presented with a left-sided swelling compared to 40% of patients in group B, 17.50% of group A and 15% of group B presented with swelling on both sides. However this difference was statistically not significant (p=0.6442).

Table 9: Comparison of cases and controls by diagnosis

Diagnosis	Cases	%	Controls	%	Total	%
BDH	7	17.50	6	15.00	13	16.25
LDH	7	17.50	11	27.50	18	22.50
LDIH	5	12.50	5	12.50	10	12.50
RDH	16	40.00	13	32.50	29	36.25
RDIH	5	12.50	5	12.50	10	12.50
Total	40	100.00	40	100.00	80	100.00
Chi-square=1.2762 P = 0.8651						

Graph 9:Comparison of cases and controls by diagnosis



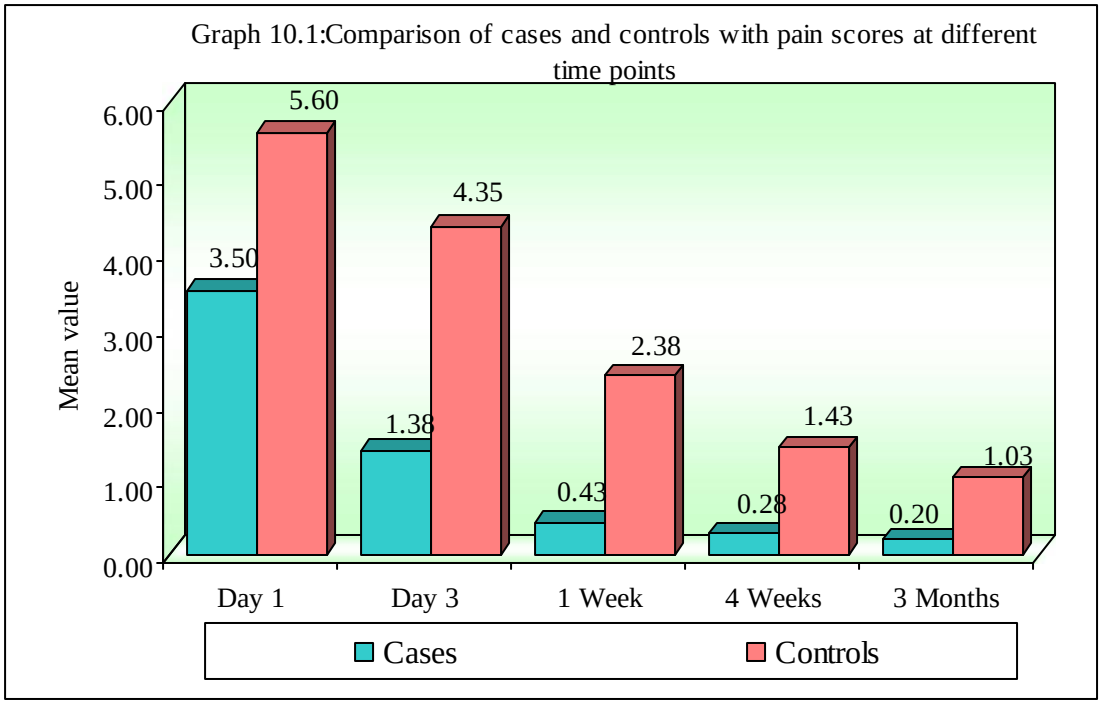
In the present study, all the patients in group A and group B had direct hernias. In group A 25% of patients had indirect hernia along with direct hernia whereas 25% of group B had indirect hernia along with direct hernia. However this difference was statistically not significant (p=0.8651).

Table 10: Comparison of cases and controls with pain scores at different time points by Mann-Whitney U test

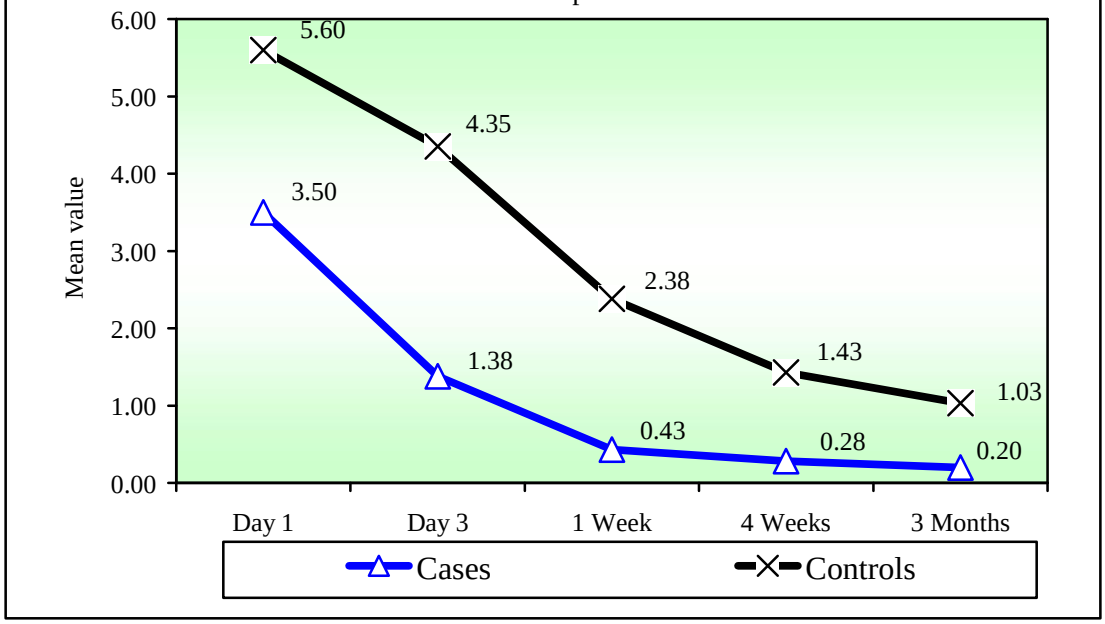
Variable	Groups	Mean	SD	Sum of ranks	U-value	Z-value	P-value
Day 1	Cases	3.50	1.40	1170.00			
	Controls	5.60	2.11	2070.00	350.00	-4.3301	0.0001*
Day 3	Cases	1.38	1.56	970.00			
	Controls	4.35	1.48	2270.00	150.00	-6.2546	0.0001*
1 Week	Cases	0.43	0.55	916.00			
	Controls	2.38	1.51	2324.00	96.00	-6.7742	0.0001*
4 Weeks	Cases	0.28	0.45	1154.00			
	Controls	1.43	1.45	2086.00	334.00	-4.4841	0.000*
3 Months	Cases	0.20	0.41	1272.00			
	Controls	1.03	1.27	1968.00	452.00	-3.3486	0.0008*
Day 1- Day 3	Cases	2.13	1.36	1909.00			
	Controls	1.25	1.24	1331.00	511.00	-2.7809	0.0054*
Day 1-1 Week	Cases	3.08	1.40	1609.50			
	Controls	3.23	1.95	1630.50	789.50	-0.1010	0.9195
Day 1-4 Weeks	Cases	3.23	1.25	1388.50			
	Controls	4.18	2.07	1851.50	568.50	-2.2276	0.0259*
Day 1-3 Months	Cases	3.30	1.26	1300.50			
	Controls	4.58	1.96	1939.50	480.50	-3.0744	0.0021*

*$p<0.05$

Graph 10.1:Comparison of cases and controls with pain scores at different time points



Graph 10.2:Comparison of cases and controls with pain scores at different time points



In the present study, the results showed the incidence of postoperative groin pain with mean severity score of 3.50±1.40 vs 5.60±2.11; 1.38±1.56 vs 4.35 ±1.48; 0.43±0.55 vs 2.38±1.51; 0.28±0.45 vs 1.43 ±1.45; and 0.20±0.41 vs 1.03±1.27at pod-1, 3,1 week, 4 weeks, and 3 months followup in group A and B respectively, were significant ($p<0.05$).

The results showed the incidence of decrease in postoperative groin pain with mean severity score of 3.08±1.40 vs 3.23±1.95 (pod-1 to 1week; p=0.9195);

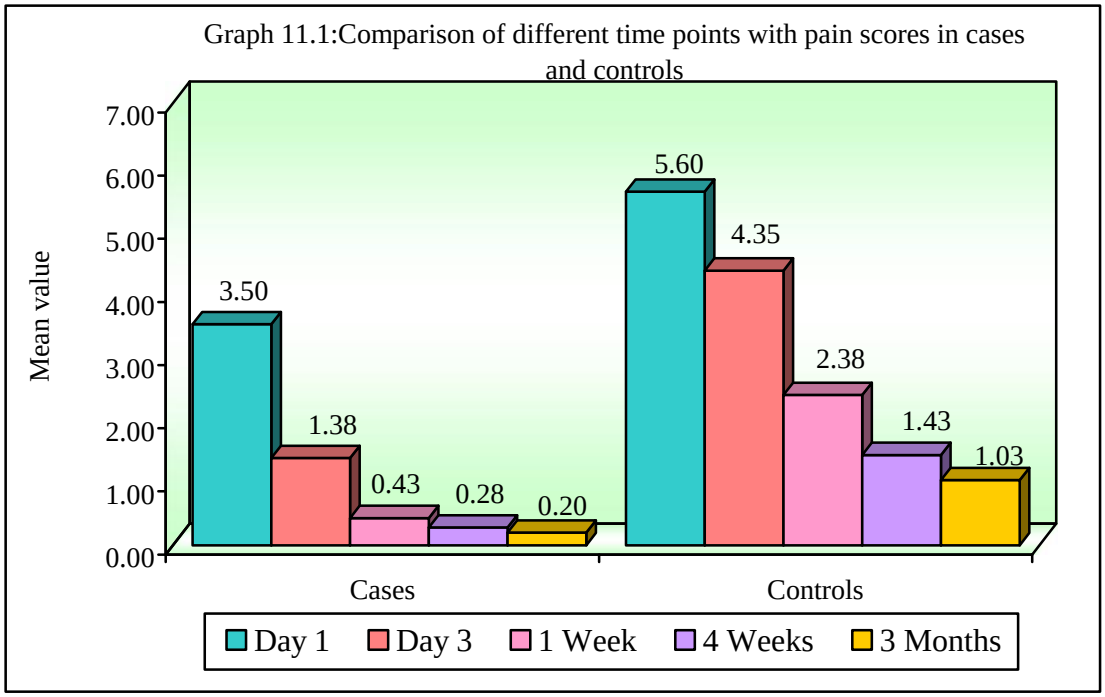
3.23±1.25 vs 4.18 ±2.07 (pod-1 to 4weeks; p=0.0259) ; and 3.30±1.26 vs 4.58±1.96 (pod-1 to 3months;p=0.021) in group A and group B respectively, were significant.

Table 11: Comparison of different time points with pain scores in cases and controls at by Wilcoxon matched pairs test

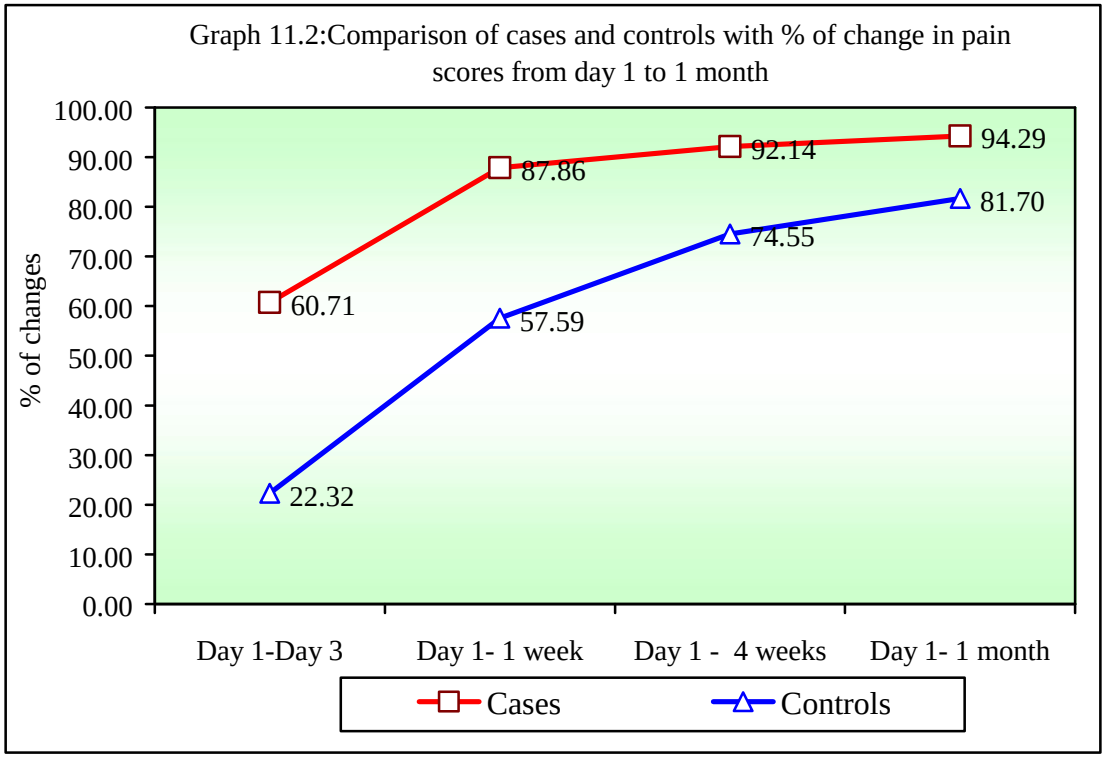
Groups	Time	Mean	Std. Dv.	Mean Diff.	SD Diff.	%of change	Z-value	P-value
Cases	Day 1	3.50	1.40	2.13	1.36	60.71	5.3731	0.0001*
	Day 3	1.38	1.56					
	Day 1	3.50	1.40	3.08	1.40	87.86	5.3741	0.0001*
	1 Week	0.43	0.55					
	Day 1	3.50	1.40	3.23	1.25	92.14	5.5109	0.0001*
	4 Weeks	0.28	0.45					
	Day 1	3.50	1.40	3.30	1.26	94.29	5.5111	0.0001*
	3 Months	0.20	0.41					
Controls	Day 1	5.60	2.11	1.25	1.24	22.32	4.3724	0.0001*
	Day 3	4.35	1.48					
	Day 1	5.60	2.11	3.23	1.95	57.59	5.3028	0.0001*
	1 Week	2.38	1.51					
	Day 1	5.60	2.11	4.18	2.07	74.55	5.5109	0.0001*
	4 Weeks	1.43	1.45					
	Day 1	5.60	2.11	4.58	1.96	81.70	5.5110	0.0001*
	3 Months	1.03	1.27					

*p<0.05

Graph 11.1:Comparison of different time points with pain scores in cases and controls



Graph 11.2:Comparison of cases and controls with % of change in pain scores from day 1 to 1 month



In this study comparing the VAS scores on all the five follow ups there were significantly lower pain scores in group A compared with group B. The mean pain scores in group A during first, second, third, fourth and fifth follow up were significantly less compared to group B and the mean reduction in pain score from first follow up to fifth follow up was significant in group A (3.30± 1.26) compared to group B(4.58 ± 1.96) (p=0.021).

Chapter 6

Discussion

DISCUSSION

Chronic groin pain is a significant problem following open hernia repair with mesh, although the pain is often mild in nature, the quality of life studies have shown that chronic pain irrespective of severity can significantly interfere with normal daily activity.[69] Chronic pain is the main problem associated with the Lichtenstein procedure with a reported rate of 15% to 40%.[64,67]

Cunningham et al were the first to bring up the issue of chronic pain[87]. Thereafter, pain became an important outcome in the field of hernia repair research. Poobalan et al reviewed the incidence of chronic pain after inguinal repair up to 2000 and found prevalence from 0% to 63% a year after surgery[86].

Routine excision of ilioinguinal nerve in an attempt to decrease the incidence of chronic inguinodynia has been proposed by many studies, yet controversies persist. So the present study was undertaken to evaluate post operative groin pain in the patients with ilioinguinal nerve excision (group A) vs ilioinguinal nerve preservation (group B) in Lichtenstein inguinal hernia repair.

In group A ilioinguinal nerve was excised carefully as lateral to the deep ring and in group B the ilioinguinal nerve carefully protected throughout the operation, extreme care was taken during surgery to avoid inclusion of nerve during suturing and mesh placement.

The patients were followed up for assessment of pain, at POD-1,3 , 1 week,4 weeks and 3 months after operation.

The groin pain was assessed by Visual Analogue Scale on a scale of 1 to 10 with 1-3 being mild pain, 4-7 being moderate pain and 8-10 being severe pain.

After the publication of several retrospective and prospective studies that showed on incidence of 6% to 29% for post herniorrhaphy inguinal pain.[70,86] Many investigators and pioneers started to establish algorithm for management of these chronic pain syndrome, others tried to define a method to prevent this complications rather than treat it.

A proposed mechanism for the development of post operative chronic groin pain is inflammation and fibrosis induced by the mesh, which is in close proximity to the ilioinguinal nerve.[70, 71]

In addition unintentional injury or strangulation of the nerve during suturing may also contribute to the phenomenon.

There is increasing evidence to suggest that prophylactic excision of ilioinguinal nerve during open hernia repair can potentially decreases the incidence of chronic groin pain following operation.[96] Because, this eliminates the possibility of inflammation neuralgia arising from entrapment, neuroma, and fibrotic reactions [87,97] .

In our study all the patients presented with groin swelling in both groups. All patients in both groups were male. The mean age, standard deviation and mean duration of the disease in group A and group B were comparable.

In this study comparing the VAS scores on all the five follow ups there were significantly lower pain scores in group A compared with group B. The mean pain scores in group A during first, second, third, fourth and fifth follow up were significantly less compared to group B and the mean reduction in pain score from first follow up to fifth follow up was significant in group A (3.30± 1.26) compared to group B(4.58 ± 1.96) (p=0.021).

In a retrospective study done by Dittrick et al 2004[96] on 90 patients who had undergone lichtenstein inguinal hernia repair. The ilioinguinal nerve was excised in 66 patients and preserved in 24 patients, concluded that the incidence of neuralgia was significantly lower in the neurectomy group versus the nerve preservation group (3% vs 26% p<0.001).At one year post operatively the neurectomy patient continued to have a significantly lower incidence of neuralgia (3% vs 25% p=0.003).

In a study conducted by Fatemeh malekpour et al 2008 [70] ,double blinded randomized controlled clinical trail was performed on 121 patients undergoing open anterior mesh repair of inguinal hernia, The chronic post surgical inguinodynia was seen in 6% in nerve excision group and 21% in nerve preserved group (p=0.033).

A study by Picchio marcello m.d et al, 2004 [97], failed to show any relationship between the division or preservation of ilioiguinal nerve and risk of developing chronic groin pain.[97] They conducted a double blinded randomized controlled trail on 813 patients, one year after surgery pain was absent in 231 (76.5) of nerve preserved and 213 (73%) of nerve transected patients. (Difference 3.30%; 95% confidence interval – 3.68% to 10.28%), mild pain in 55(18%) and moderate in 11 (4%) and 9 (3%), and severe in 5(2%) and 9 (3%). Respectively p=55 pearson test.

These controversial result, as well an article by madura et al [14] - reporting the effectiveness of inguinal neurectomy for inguinal nerve entrapment to relieve pain in post surgical patients motivated us to study the comparison between elective ilio-inguinal nerve excision versus preservation on chronic groin pain and other symptoms.

The present study showed the role of ilioinguinal neurectomy in reducing postoperative pain

In the present study

A prospective comparative study conducted at department of surgery at kle's prabhakar kore hospital and medical research centre, Belagavi, from jan2016 to dec2016 with 3 months follow up. All 80 patients have completed the study adherent to the protocol this includes 40 patients in group A (ilioinguinal nerve excision) and 40 patients in group B (ilioinguinal nerve preserved).

The results showed the incidence of postoperative groin pain with mean severity score of 3.50±1.40 vs 5.60±2.11 ; 1.38±1.56 vs 4.35 ±1.48 ; 0.43±0.55 vs 2.38±1.51;0.28±0.45 vs 1.43 ±1.45 ; and 0.20±0.41 vs 1.03±1.27at pod-1, 3,1 week, 4 weeks, and 3 months followup in group A and B respectively, were significant ($p<0.05$).

The results showed the incidence of decrease in postoperative groin pain with mean severity score of 3.08±1.40 vs 3.23±1.95(pod-1 to 1week;p=0.9195) ; 3.23±1.25 vs 4.18 ±2.07(pod-1 to 4weeks;p=0.0259) ; and 3.30±1.26 vs 4.58±1.96 (pod-1 to 3months;p=0.021) in group A and group B respectively, were significant.

Thus showed the incidence of chronic groin pain is lower in ilioinguinal nerve excision (group A) compared to nerve preservation (group B) and statistically significant ($p<0.05$).

However the sample size and the follow up period in the current study is relatively short, a larger study sample and longer follow-up may be needed.

Chapter 7

Conclusion

CONCLUSION

Based on the findings of the present study it may be concluded that, the elective division of ilioinguinal nerve significantly reduced the post-operative pain as compared to preservation of ilioinginal nerve in Lichtenstein hernia repair.

However the sample size and the follow up period in the current study is relatively short , a larger study sample and longer follow-up may be needed before any further conclusion can be made.

Although the study sample and follow period is short in this present study than the previous studies, it is still wise to recommend ilioinguinal neurectomy in patients undergoing anterior inguinal hernia mesh repair. So when performing Lichtenstein inguinal hernia repair, routine ilioinguinal neurectomy is a reasonable option.

Chapter 8

Summary

SUMMARY

Chronic groin pain is a significant problem following open hernia repair with mesh, although the pain is often mild in nature, the quality of life studies have shown that chronic pain irrespective of severity can significantly interfere with normal daily activity. Chronic pain is the main problem associated with the Lichtenstein procedure with a reported rate of 15% to 40%. Routine excision of ilioinguinal nerve in an attempt to decrease the incidence of chronic inguinodynia has been proposed by many studies, yet controversies persists. So the present study was undertaken.

The objective of the present study is to compare the incidence of postoperative pain following Lichtenstein inguinal hernia repair in elective division of ilioinguinal nerve versus preservation of ilioinguinal nerve.

The present one year randomized controlled trial was conducted in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi from January 2016 to December 2016. A total of 80 patients undergoing Lichtenstein hernia repair were randomized into two groups of 40 each as group A (excision of ilioinguinal nerve) and group B (preservation of ilioinguinal nerve).

In the present study all the patients in both the groups were males. The mean age (52.48 ± 14.31 vs 55.93 ± 14.25 years; p=0.2836) and duration of the symptoms (0.99 ± 0.90 years vs 1.12 ± 0.85 years; p=0.5334) in group A and group B was comparable. In this study comparing the VAS on all the five follow ups there was significant lower pain scores in ilioinguinal nerve excision group

than ilioinguinal nerve preservation group. , the results showed the incidence of postoperative groin pain with mean severity score of 3.50±1.40 vs 5.60±2.11 ; 1.38±1.56 vs 4.35 ±1.48 ; 0.43±0.55 vs 2.38±1.51;0.28±0.45 vs 1.43 ±1.45 ; and 0.20±0.41 vs 1.03±1.27at pod-1, 3,1 week, 4 weeks, and 3 months followup in group A and B respectively, were significant ($p<0.05$). The results showed the incidence of decrease in postoperative groin pain with mean severity score of 3.08±1.40 vs 3.23±1.95(pod-1 to 1week;p=0.9195) ; 3.23±1.25 vs 4.18 ±2.07(pod-1 to 4weeks;p=0.0259) ; and 3.30±1.26 vs 4.58±1.96 (pod-1 to 3months;p=0.021) in group A and group B respectively, were significant.Showing that the elective division of ilioinguinal nerve significantly reduced the post-operative pain as compared to preservation of ilioinginal nerve in Lichtenstein hernia repair.

However the sample size and the follow up period in the current study is relatively short , a larger study sample and longer follow-up may be needed before any further conclusion can be made.

Although the study sample and follow period is short in this present study than the previous studies, it is still wise to recommend ilioinguinal neurectomy in patients undergoing anterior inguinal hernia mesh repair. So when performing Lichtenstein inguinal hernia repair, routine ilioinguinal neurectomy is a reasonable option.

Chapter 9

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Annexures

Annexure I

ANNEXURE I – CONSENT FORM

Mr/Mrs/Miss. _____ we are requesting you to enroll yourself in study titled **"**COMPARISON OF POSTOPERATIVE PAIN IN ELECTIVE DIVISION VERSUS PRESERVATION OF ILIOINGUINAL NERVE IN LICHTENSTEIN INGUINAL HERNIA REPAIR**"** A ONE YEAR SINGLE BLINDED RANDOMIZED CONTROL TRIAL AT KLES DR PRABHAKAR KORE HOSPITAL AND MRC, BELAGAVI conducted by Dr._____, Post Graduate in M.S. General Surgery under the guidance of Dr. _____ . Professor, Department of General Surgery, J.N. Medical College, Belagavi under KLE university, Belagavi.

Respected Sir/Madam, We request you to participate in our study as you are eligible for participating in the study. Your participation in the research is absolutely voluntary. Your decision to participate in the study or otherwise will not affect the relationship with kle hospital. If you decide not to participate, you are free to to withdraw at any time. During the study your operative outcome will be accessed by some questions which will be answered by your operating surgeon.

Purpose of the study:

Chronic pain is one of the serious problem faced after the open inguinal hernia repair. Ilioinguinal nerve is the most commonly involved nerve for causing chronic groin pain after hernia repair. This study is conducted to evaluate the effect of elective division or preservation of the ilionguinal nerve on post operative inguinal pain in Lichtenstein inguinal hernia repair.

Procedure Involved:

If you agree to enroll yourself in my study, you will be asked your detail history. Then you will be clinically examined in detail and routine investigations like HB, TC, DC, PLATELET COUNT, RBS, BLOOD UREA, SERUM CREATININE, BLOOD GROUPING, CHEST X RAY, ECG, will be done accordingly. Computer generated random numbers are used to assign the type of surgery to the patients that is, group A and group B. Two procedures are followed in the repair of hernia viz. division of ilioinguinal nerve (group A) and preservation of ilioinguinal nerve (group B) during Lichtenstein inguinal hernia repair are compared in the study. In division of ilioinguinal nerve benefits include reduction of post operative pain, risks include loss of sensation to the area supplied by the nerve such as skin over the groin region, medial aspect of thigh, the upper part of scrotum and penile root. In preservation of ilioinguinal nerve there could be post operative pain due to nerve entrapment and due to perineural fibrosis. The patients are monitored for pain by visual analogue scale ranging from 0 to 10 considering 0 as no pain and 10 as maximum pain postoperatively from day1, day3, 1st week, 4th week and 3rd month.

Risks and Benefits:

There is no increased risk involved in becoming a part of this study and the complications are those which are normally anticipated. This study will help to estimate the incidence of postoperative pain in comparison with the two procedures involved. The results derived at the end of study will benefit all similar patients admitted in this hospital.

Withdrawing/removal from the study

The participant has freedom to withdraw from the study whenever he/she wishes and with any prior notice. Even if you decline to participate, there will not be any change in the line of your management or the relationship with your doctor. You will be told about all the new information that affects your decision to participate in the study. The investigator may also exclude a participant from the study at anytime.

Privacy and Confidentiality:

The only people to know that you are a research subject are members of the research team. No information about you or information provided by you during the research will be disclosed to other without your written permission except:

1. In emergency to protect your rights and welfare.
2. If required by law.

Institutional/sponsors policy:

If any unforeseen complications or injury occurs during the period of study the participant will be given treatment within the limitations of KLE's prabhakar kore hospital general ward.

Financial Incentives for participation:

The participant neither gets any financial incentives during the period of study nor will be asked to pay for the purpose of this study.

Authorization to Publish Results:

When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with your identity remaining confidential.

Contact details

The participant can contact me at any time during the study period for clarification of doubts or any questions. In case of any queries, you can contact the following

DR _____
Professor,
Department of Surgery
J.N.Medical College,
KLE University, Belagavi-10
Ph no: _____

DR. _____
Postgraduate student,
Department of surgery,
J.N.Medical College,
KLE University, Belagavi-10
Ph no: _____

DR. _____
Professor of pathology and chairman,
JNMC institutional ethics committee on human subjects research,
J. N. Medical College,
KLE University,
Belagavi – 10.
Ph no: _____

CONSENT STATEMENT

I, Mr/Ms/Mrs. _____ voluntarily agree for the participation as a subject of study. By signing this consent form I am not giving up any of my legal rights, I may withdraw from the study anytime. I am signing the consent form after having read or been read for me in my vernacular language, including the risks and the benefits and having all my questions answered.

Subject Name : _____

Signature or the Left Thumb Print of Subject : _____

Witness Name: _____ Signature: _____

Investigators Name: _____ Signature: _____

Date: _____

Place: _____

Annexures

Annexure II

ANNEXURE II – PROFORMA

PROFORMA OF CLINICAL EXAMINATION OF INDIVIDUAL PATIENT

Name : Age :

Address : IP no.:

Sex : Religion:

Education: Date of admission:

Occupation: Date of discharge:

HISTORY

When did the patient notice the swelling:

Size of the swelling :

Associated features : Abdominal pain[colicky/dragging sensation]

Does the swelling automatically disappear on lying down: Yes / No

Other complaints :

Past History:

Family History:

GENERAL PHYSICAL EXAMINATION:

Built and Nourishment:

Weight :

Pallor / Icterus / Cyanosis / Clubbing / Edema / Lymphadenopathy:

Vital Signs :

PR: RR:

BP: Temperature:

SYSTEMIC EXAMINATION:

Per Abdomen:

Respiratory System:

Central Nervous System:

Cardio-Vascular System:

LOCAL EXAMINATION: patient examined in standing and supine position.

INSPECTION:

Size: Reduciblity:

Shape: Cough impulse:

Extension of swelling: Position of the penis:

PALPATION:

Local rise of temperature: Cough impulse:

Tenderness: Reducibility of the swelling:

Consistency: Internal ring acclusion test:

Genital examination:Phymosis/stricture/pin hole meatus

PERCUSSION:

AUSCULTATION:

Per rectal examination:Prostatomegaly(BPH)

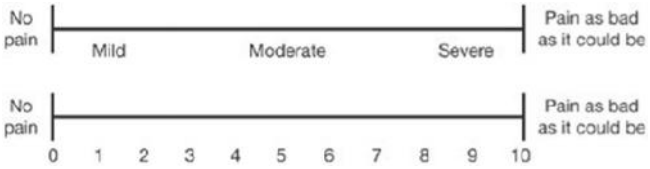
DIAGNOSIS:

INVESTIGATION:

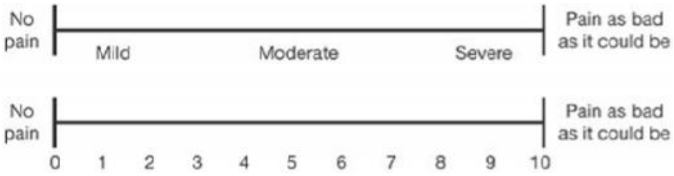
PROCEDURE DONE:

EVALUATION OF PAIN:

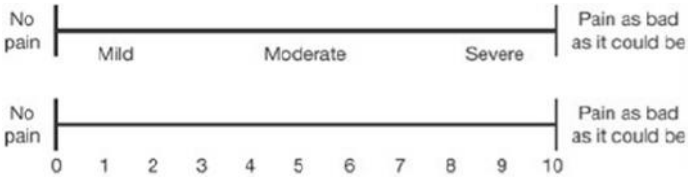
POSTOPERATIVE DAY 1:



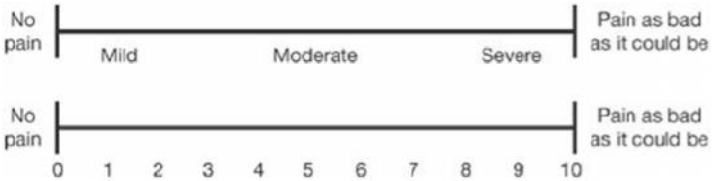
POSTOPERATIVE DAY 3:



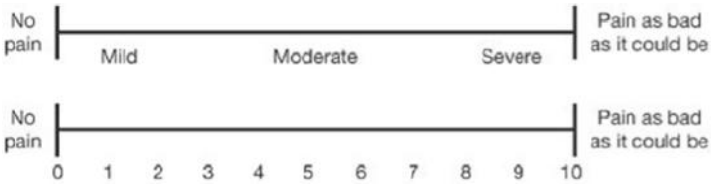
AFTER 1 WEEK: [before discharge]



AFTER 4 WEEKS:



AFTER 3 MONTHS:



DURATION OF SURGERY: **1) Right side: _____** minutes**.**

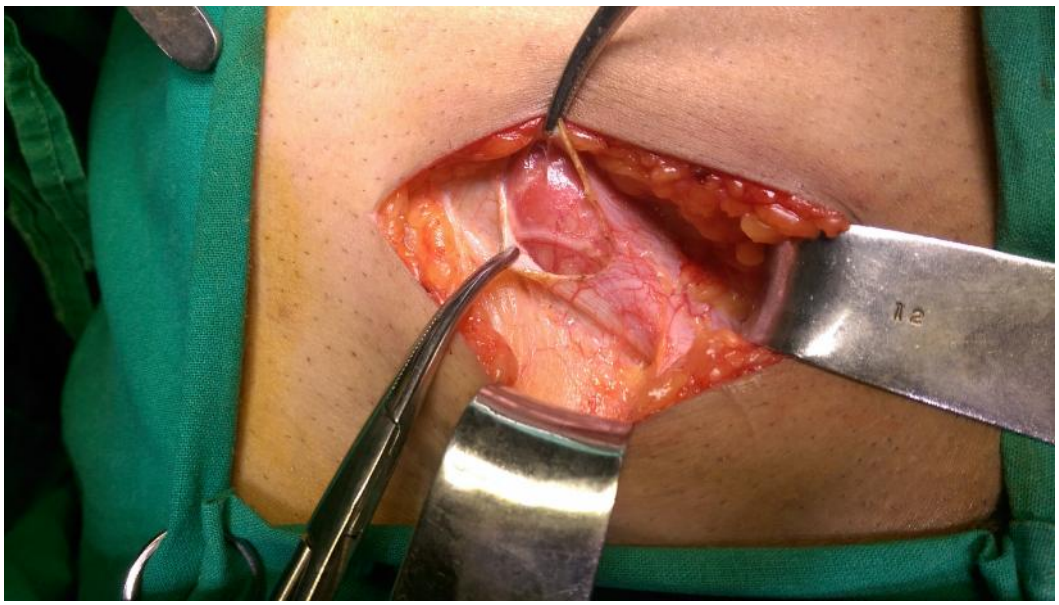
2) Left side: _____ minutes

Annexures

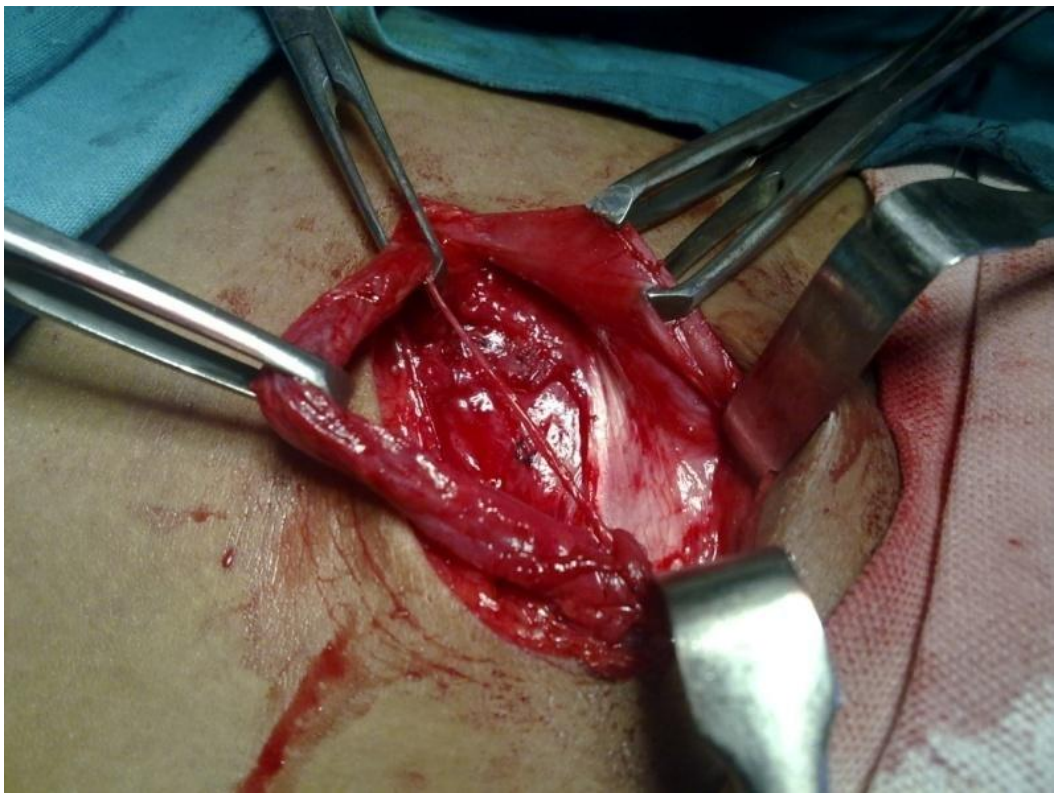
Annexure III

ANNEXURE III – PHOTOGRAPHS

Photograph 1. Opening of external oblique aponeurosis

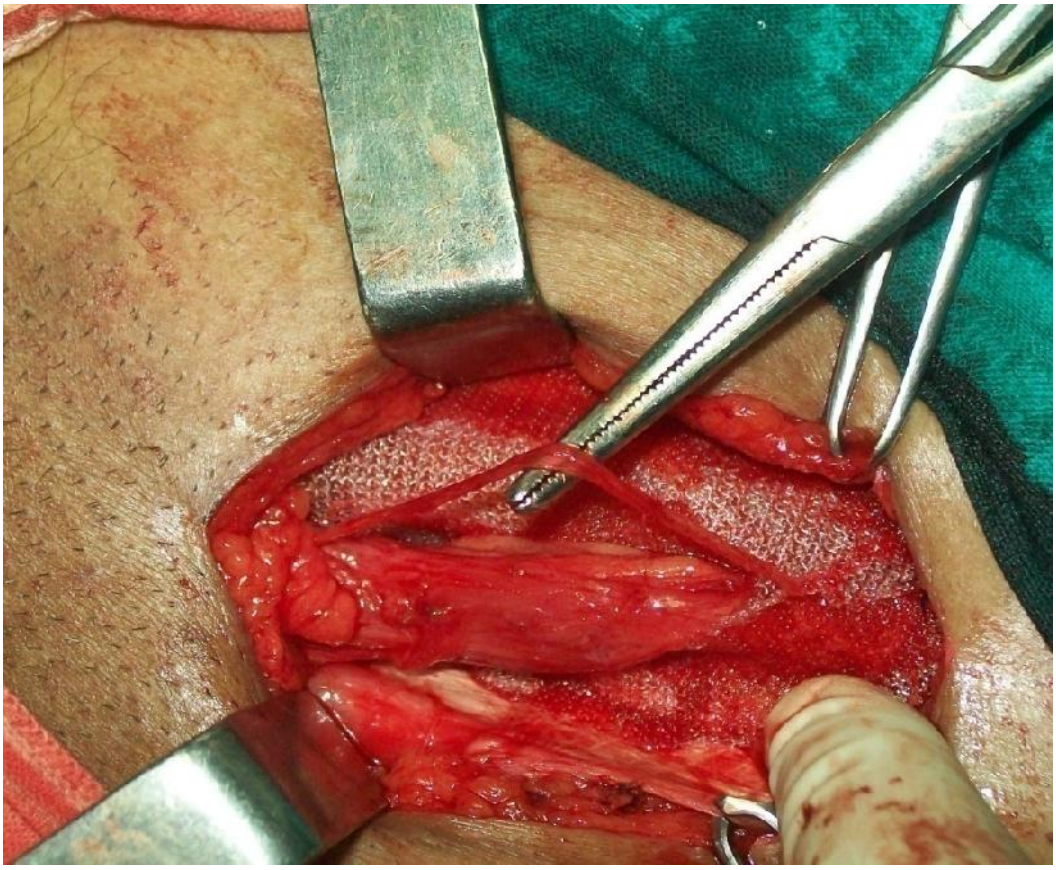


A



B

Photograph 2: Ilioinguinal Nerve during operation(A and B)



Photograph 3. Polypropylene Mesh placement

Photograph 4. Excised part of ilioinguinal nerve

Annexures

Annexure IV

ANNEXURE IV – MASTER CHART

-	-	Absent
+	-	Present
BL	-	Bilateral
BDH	-	Bilateral direct hernia
BP	-	Blood pressure
Cms	-	Centimeters
L	-	Left
LDIH	-	Left Direct Indirect Hernia
M	-	Male
m	-	Month
mm Hg	-	Millimeters of mercury
R	-	Right
RDIH	-	Right Direct Indirect Hernia
VAS	-	Visual analog scale
Wks	-	Weeks
y	-	Year

ANNEXURE IV - MASTER CHART - GROUP SP

Serial Number	In patient Number	Sex	Age (Years)	Duration	General physical examination		Per abdomen					Diagnosis	Assessment of pain (VAS score)				
							Inspection			Palpation							
					pulse	BP(mm Hg)	Size (Cms)	Cough impulse	Position	Reducibility	Tenderness		Day 1	Day 3	One Week	4 Weeks	3 Months
1	743480	M	63	6m	80	120/70	3*6	+	R	+	-	RDH	5	2	1	1	1
2	744620	M	50	2y	70	130/80	4*5	+	R	+	-	RDIH	1	0	0	0	0
3	744873	M	38	2m	82	110/70	3*3	+	R	+	-	RDH	3	1	1	0	0
4	743321	M	50	1y	80	120/80	3*5	+	L	+	-	LDIH	5	1	1	1	1
5	739130	M	75	1y	78	120/70	4*5	+	BL	+	-	BDH	3	1	1	1	0
6	735859	M	44	3m	80	126/80	3*3	+	L	+	-	LDH	4	3	2	1	0
7	738470	M	65	6m	82	110/80	5*4	+	L	+	-	LDH	2	1	0	0	0
8	722175	M	50	1m	84	120/70	4*2	+	L	+	-	LDIH	6	5	0	0	0
9	729413	M	63	1y	80	110/70	2*3	+	R	+	-	RDH	3	0	0	0	0
10	733156	M	70	2y	78	130/86	4*5	+	BL	+	-	BDH	4	1	0	0	0
11	732958	M	25	4m	80	120/70	4*3	+	L	+	-	LDIH	3	1	1	1	1
12	735532	M	55	6m	80	140/70	4*2	+	BL	+	-	BDH	5	1	1	1	0
13	746549	M	28	4m	76	110/80	2*3	+	R	+	-	RDH	3	2	1	0	0
14	747956	M	60	3y	78	120/80	4*4	+	R	+	-	RDIH	5	1	1	1	1
15	749014	M	35	4m	70	110/70	2*3	+	R	+	-	RDH	1	1	1	0	0
16	749753	M	60	8m	80	120/70	2*2	+	R	+	-	RDH	2	1	0	0	0
17	749968	M	49	1y	78	108/80	3*3	+	L	+	-	LDH	4	0	0	0	0
18	750283	M	70	2y	70	120/70	3*5	+	R	+	-	RDIH	5	0	0	0	0
19	751215	M	72	1y	80	110/70	3*3	+	L	+	-	LDH	3	0	0	0	0
20	749525	M	36	2y	86	110/70	2*2	+	L	+	-	LDH	5	4	1	1	1
21	751466	M	64	1y	80	110/80	3*3	+	R	+	-	RDH	2	0	0	0	0
22	781386	M	64	2y	76	130/80	2*5	+	BL	+	-	BDH	5	4	0	0	0
23	752326	M	28	1y	80	110/70	2*4	+	L	+	-	LDIH	2	0	0	0	0
24	752649	M	65	6m	70	110/70	3*3	+	R	+	-	RDH	5	4	1	1	1
25	749986	M	52	2y	86	120/70	3*2	+	R	+	-	RDH	3	2	1	0	0
26	753884	M	65	1y	70	110/80	2*2	+	R	+	-	RDH	3	0	0	0	0
27	754712	M	64	6m	76	116/80	2*3	+	BL	+	-	BDH	5	4	0	0	0
28	754376	M	41	3y	72	110/70	3*4	+	R	+	-	RDIH	2	1	0	0	0
29	755878	M	41	1y	70	100/70	3*2	+	R	+	-	RDH	4	0	0	0	0
30	754341	M	65	1y	80	120/70	3*3	+	R	+	-	RDH	3	0	0	0	0
31	756252	M	39	2y	80	130/80	3*3	+	L	+	-	LDH	1	1	1	0	0
32	756660	M	55	1y	90	110/70	3*2	+	R	+	-	RDH	2	1	0	0	0
33	756478	M	62	2y	70	116/70	3*2	+	BL	+	-	BDH	4	0	0	0	0
34	757167	M	25	2y	80	110/70	4*2	+	L	+	-	LDH	5	0	0	0	0
35	756758	M	55	5m	78	120/70	4*5	+	R	+	-	RDIH	3	0	0	0	0
36	757373	M	40	1y	80	130/70	5*6	+	R	+	-	RDH	5	4	1	1	1
37	757382	M	50	6m	70	120/78	2*4	+	L	+	-	LDIH	2	0	0	0	0
38	757413	M	35	1y	76	110/68	2*3	+	BL	+	-	BDH	5	4	0	0	0
39	758148	M	75	2y	86	130/78	2*2	+	R	+	-	RDH	2	0	0	0	0
40	758373	M	56	6m	78	130/80	4*2	+	R	+	-	RDH	5	4	1	1	1

ANNEXURE IV - MASTER CHART - GROUP RP

Serial Number	In patient Number	Sex	Age (Years)	Duration	General physical examination		Per abdomen					Diagnosis	Assessment of pain (VAS score)				
							Inspection			Palpation							
					Pulse	BP(mm Hg)	Size (Cms)	Cough impulse	Position	Reducibility	Tenderness		Day 1	Day 3	One Week	4 Weeks	3 Months
1	746786	M	64	6m	70	130/80	3*6	+	R	+	-	RDH	8	6	6	4	4
2	745342	M	60	6m	80	120/70	3*3	+	L	+	-	LDH	2	2	2	1	1
3	743694	M	70	2y	78	120/70	4*6	+	L	+	-	LDIH	6	4	1	1	1
4	743984	M	70	2m	82	130/80	2*4	+	R	+	-	RDIH	2	2	2	1	0
5	723413	M	70	3y	80	130/80	4*5	+	R	+	-	RDIH	6	6	5	5	4
6	725877	M	56	1y	70	120/70	3*3	+	L	+	-	LDH	2	2	2	1	1
7	728311	M	41	1y	78	110/70	2*3	+	BL	+	-	BDH	4	4	3	1	1
8	729331	M	54	6m	88	100/70	4*5	+	L	+	-	LDH	7	6	2	1	0
9	729355	M	55	1y	72	120/70	3*3	+	R	+	-	RDH	3	3	2	2	1
10	730110	M	50	2y	80	120/78	4*2	+	BL	+	-	BDH	7	7	5	5	4
11	728650	M	80	2y	80	110/80	3*3	+	L	+	-	LDIH	3	2	2	2	1
12	734994	M	38	2y	80	108/70	2*2	+	L	+	-	LDH	5	5	2	1	0
13	735217	M	65	2m	76	108/70	1*5	+	BL	+	-	BDH	3	2	2	2	1
14	734424	M	39	2y	80	130/80	3*3	+	L	+	-	LDH	4	3	2	0	0
15	735377	M	55	1y	90	110/70	3*2	+	R	+	-	RDH	9	7	6	5	4
16	743488	M	62	2y	70	116/70	3*2	+	BL	+	-	BDH	4	2	1	0	0
17	743348	M	25	2y	80	110/70	4*2	+	L	+	-	LDH	6	4	2	2	1
18	744028	M	55	5m	78	120/70	4*5	+	R	+	-	RDIH	4	4	1	0	0
19	744328	M	40	1y	80	130/70	5*6	+	R	+	-	RDH	5	5	2	0	2
20	746511	M	50	6m	70	120/78	2*4	+	L	+	-	LDIH	9	5	1	1	1
21	736371	M	35	1y	76	110/68	2*3	+	BL	+	-	BDH	5	5	2	1	0
22	736718	M	75	2y	86	130/78	2*2	+	R	+	-	RDH	9	6	5	1	1
23	736383	M	56	6m	78	130/80	4*2	+	R	+	-	RDH	5	4	2	1	0
24	737030	M	70	2y	80	108/70	4*2	+	L	+	-	LDIH	5	5	2	2	0
25	737333	M	70	1y	80	140/88	4*5	+	R	+	-	RDH	8	5	2	1	0
26	736103	M	55	2y	76	11076	4*2	+	R	+	-	RDH	6	5	1	1	1
27	737090	M	35	6m	80	100/70	3*4	+	L	+	-	LDH	8	5	1	1	1
28	737826	M	75	1y	80	130/80	4*2	+	R	+	-	RDH	6	5	1	1	1
29	738110	M	60	2y	78	120/70	4*4	+	R	+	-	RDIH	7	4	2	0	0
30	738445	M	64	1y	86	120/80	4*6	+	L	+	-	LDH	6	4	2	2	1
31	738512	M	35	4m	70	110/70	2*3	+	R	+	-	RDH	4	3	2	0	0
32	738645	M	60	8m	80	120/70	2*2	+	R	+	-	RDH	9	7	6	5	4
33	739504	M	49	1y	78	108/80	3*3	+	L	+	-	LDH	4	2	1	0	0
34	739586	M	70	2y	70	120/70	3*5	+	R	+	-	RDIH	6	4	2	2	1
35	740913	M	72	1y	80	110/70	3*3	+	L	+	-	LDH	4	4	1	0	0
36	741177	M	36	2y	86	110/70	2*2	+	L	+	-	LDH	5	5	2	0	2
37	741217	M	64	1y	80	110/80	3*3	+	R	+	-	RDH	9	5	1	1	1
38	742224	M	64	2y	76	130/80	2*5	+	BL	+	-	BDH	5	5	2	1	0
39	746786	M	28	1y	80	110/70	2*4	+	L	+	-	LDIH	9	6	5	1	1
40	747315	M	65	6m	70	110/70	3*3	+	R	+	-	RDH	5	4	2	1	0